We build a better future

- Service guide: Hyundai -7 AC range -

HYUNDAI
HEAVY INDUSTRIES EUROPE
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- Introduction Hyundai’s production plant (Ulsan).

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- General AC machine's introduction.

- **New AC Battery models: - 15/18/20BT-7**
  - 16/18/20B-7
  - 22/25/30/32B-7
  - 22/25/30BHA-7
  - 35/40/45/50B-7

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General machines introductions

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- 15/18/20BT-7, 16/18/20B-7 Model introduction.

- ZAPI AC Dual AC2 drive controller (48V).
- ZAPI AC 2 Flash inverter (Hydr.) (48V).
- 2 x Sauer Danfoss drive motor . (4,4Kw).
- 1 x Sauer Danfoss Hydr. motor. (15,8Kw)
- ZF transmissions with integrated wet brake
- Calibration through calibrator or display.
- 3 user modes selectable (H, N, E).
- Travel speed 16 – 17 km/h.
- Standard integrated mast profiles.
- Fingertip control available as an option.

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Identification

1. 1	Manufacturer		HYUNDAI	HYUNDAI	HYUNDAI
1. 2	Type		15BT-7	18BT-7	20BT-7
1. 3	Drive : electric (battery or mains), diesel, petrol, fuel gas, manual		Electric	Electric	Electric
1. 4	Type of operation : hand, pedestrian, standing, seated, order-picker		Seated	Seated	Seated
1. 5	Load capacity / rated load	Q (t)	1.5	1.8	2.0
1. 6	Load center distance	c mm (in)	500 (24)	500 (24)	500 (24)
1. 8	Load distance, center of drive axle to fork	x mm (in)	360 (14.2)	360 (14.2)	365 (14.4)
1. 9	Wheelbase	y mm (in)	1,355 (53.3)	1,440 (56.7)	1,440 (56.7)

Weights

2. 1	Service weight	kg (lb)	2,980 (6,570)	3,180 (7,011)	3,337 (7,357)
2. 2	Axle loading, loaded front / rear	kg (lb)	3,980/500 (8,774/1,102)	4,352/578 (9,594/1,274)	4,753/584 (10,478/1,288)
2. 3	Axle loading , unloaded front / rear	kg (lb)	1,500/1,480 (3,307/3,263)	1,543/1,637 (3,402/3,609)	1,537/1,800 (3,389/3,969)

Wheels, Chassis

3. 1	Tires : solid rubber, superelastic, pneumatic, polyurethane		Superelastic	Superelastic	Superelastic
3. 2	Tires size, front (Φ x width)		18 x 7 - 8	18 x 7 - 8	200 / 50 - 10
3. 3	Tires size, rear (Φ x width)		15 x 4.5 - 8	15 x 4.5 - 8	15 x 4.5 - 8
3. 5	Wheels, number front / rear (x = driven wheels)		2x / 2	2x / 2	2x / 2
3. 6	Track width, front	mm (in)	895 (35.2)	895 (35.2)	905 (35.6)
3. 7	Track width, rear	mm (in)	170 (6.7)	170 (6.7)	170 (6.7)

Basic Dimensions

4. 1	Mast / fork carriage tilt forward / backward (α/β)	degrees	5 / 7	5 / 7	5 / 7
4. 2	Lowered mast height	h1 mm (in)	2,120 (83.5)	2,120 (83.5)	2,129 (83.8)
4. 3	Free lift	h2 mm (in)	135 (5.3)	135 (5.3)	135 (5.3)
4. 4	Lift height	h3 mm (in)	3,300 (130)	3,300 (130)	3,300 (130)
4. 5	Extended mast height	h4 mm (in)	4,332 (170.6)	4,332 (170.6)	4,332 (170.6)
4. 7	Overhead load guard (cab) height	h5 mm (in)	1,970 (77.6)	1,970 (77.6)	1,980 (78)
4. 8	Seat height	h7 mm (in)	920 (36.2)	920 (36.2)	930 (36.6)
4. 12	Coupling height	h10 mm (in)	410 (16.1)	410 (16.1)	410 (16.1)
4. 19	Overall length	l1 mm (in)	2,815 (110.8)	2,900 (114.2)	2,945 (116)
4. 20	Length to face of forks	l2 mm (in)	1,915 (75.4)	2,000 (78.7)	2,045 (80.5)
4. 21	Overall width	b1 mm (in)	1,100 (43.3)	1,100 (43.3)	1,105 (43.5)
4. 22	Fork dimensions	S x E x L mm (in)	900x100x35 (35.4x3.9x1.4)	900x100x35 (35.4x3.9x1.4)	900x100x40 (35.4x3.9x1.6)
4. 23	Fork carriage ISO 2328, class / type A, B		II A	II A	II A
4. 24	Fork - carriage width	mm (in)	980 (38.6)	980 (38.6)	980 (38.6)
4. 31	Ground clearance, loaded, under mast	m1 mm (in)	85 (3.3)	85 (3.3)	94 (3.7)
4. 32	Ground clearance, centre of wheelbase	m2 mm (in)	90 (3.5)	90 (3.5)	100 (3.9)
4. 33	Aisle width for pallets 1000 x 1200 crossways	Ast mm (in)	3,255 (128.1)	3,330 (131.1)	3,370 (132.7)
4. 34	Aisle width for pallets 800 x 1200 lengthways	Ast mm (in)	3,075 (121.1)	3,150 (124)	3,190 (125.6)
4. 35	Turning radius	Wa mm (in)	1,570 (61.8)	1,645 (64.8)	1,685 (66.3)
4. 36	Smallest pivot point distance	mm (in)	-	-	-

Performance Data

5. 1	Travel speed, loaded / unloaded	(48V) km/h (mph)	16/17 (3.4/3.6)	16/17 (3.4/3.6)	16/17 (3.4/3.6)
		(36V) km/h (mph)	15/16 (3.2/3.4)	15/16 (3.2/3.4)	15/16 (3.2/3.4)
5. 2	Lift speed, loaded / unloaded	(48V) mm/sec (fpm)	410/600 (80.7/118.1)	410/600 (80.7/118.1)	410/600 (80.7/118.1)
		(36V) mm/sec (fpm)	330/500 (65/98.4)	330/500 (65/98.4)	330/500 (65/98.4)
5. 3	Lowering speed, loaded / unloaded	mm/sec (fpm)	500/450 (98.4/88.6)	500/450 (98.4/88.6)	500/450 (98.4/88.6)
5. 5	Drawbar pull, S2 30 min	(loaded) N	3,300	3,252	2,992
		(unloaded) N	3,427	3,388	3,198
5. 6	Max. drawbar pull, S2 5 min	(loaded) N	15,102	15,190	14,367
		(unloaded) N			
5. 7	Gradient performance, S2 3 min	(loaded) %	-	-	-
		(unloaded) %	-	-	-
5. 8	Max. gradient performance, S2 5 min	(loaded) %	29.5	27.5	24.5
5. 10	Service brake	-	Hydraulic	Hydraulic	Hydraulic

E - Motor

6. 1	Drive motor rating S2 60 min	(48 V / 36 V) kW	4.4 / 3.5	4.4 / 3.5	4.4 / 3.5
6. 2	Pump motor rating at S3 - 15 %	(48 V / 36 V) kW	15.8 / 9.9	15.8 / 9.9	15.8 / 9.9
6. 4	Battery voltage, nominal capacity K5	(48 V / 36 V) Ah	505 / 800	585 / 1,000	585 / 1,000
6. 5	Battery weight (min)	kg (lb)	710 (1,565)	835 (1,841)	835 (1,841)
	Battery dimensions L / W /H	mm (in)	990/545/636 (39/21.5/25)	990/545/630 (39/24.8/25)	990/545/630 (39/24.8/25)
6. 6	Type of drive control	-	AC	AC	AC

Specifications

Identification

1. 1	Manufacturer		HYUNDAI	HYUNDAI	HYUNDAI
1. 2	Type		16B-7	18B-7	20B-7
1. 3	Drive : electric (battery or mains), diesel, petrol, fuel gas, manual		ELECTRIC	ELECTRIC	ELECTRIC
1. 4	Type of operation : hand, pedestrian, standing, seated, order-picker		SEATED	SEATED	SEATED
1. 5	Load capacity / rated load	Q kg	1,600	1,750	2,000
1. 6	Load center distance	c mm	500	500	500
1. 8	Load distance, center of drive axle to fork	x mm	360	360	365
1. 9	Wheelbase	y mm	1,355	1,440	1,440

Weights

2. 1	Service weight	kg	2,995	3,195	3,300
2. 2	Axle loading, loaded front / rear	kg	4,094 / 501	4,403 / 592	4,724 / 576
2. 3	Axle loading , unloaded front / rear	kg	1,463 / 1,532	1,513 / 1,682	1,513 / 1,787

Wheels, Chassis

3. 1	Tires : solid rubber, superelastic, pneumatic, polyurethane		SE	SE	SE
3. 2	Tires size, front (Φ x width)		18 x 7-8	18 x 7-8	200 / 50-10
3. 3	Tires size, rear (Φ x width)		16 x 6-8	16 x 6-8	16 x 6-8
3. 5	Wheels, number front / rear (x = driven wheels)		2 x /2	2 x /2	2 x /2
3. 6	Track width, front	mm	895	895	905
3. 7	Track width, rear	mm	880	880	880

Basic Dimensions

4. 1	Mast / fork carriage tilt forward / backward (α/β)	degrees	5 / 7	5 / 7	5 / 7
4. 2	Lowered mast height	h1 mm	2,120	2,120	2,129
4. 3	Free lift	h2 mm	135	135	140
4. 4	Lift height	h3 mm	3,300	3,300	3,300
4. 5	Extended mast height	h4 mm	4,332	4,332	4,332
4. 7	Overhead load guard (cab) height	h5 mm	1,970	1,970	1,980
4. 8	Seat height	h7 mm	920	920	930
4. 12	Coupling height	h10 mm	250	250	250
4. 19	Overall length	l1 mm	2,931	3,016	3,031
4. 20	Length to face of forks	l2 mm	2,031	2,116	2,131
4. 21	Overall width	b1 mm	1,100	1,100	1,105
4. 22	Fork dimensions	S x E x L mm	900 x 100 x 35	900 x 100 x 35	900 x 100 x 40
4. 23	Fork carriage ISO 2328, class / type A, B		II A	II A	II A
4. 24	Fork - carriage width	b3 mm	980	980	980
4. 31	Ground clearance, loaded, under mast	m1 mm	85	85	94
4. 32	Ground clearance, centre of wheelbase	m2 mm	90	90	100
4. 33	Aisle width for pallets 1,000 x 1,200 crossways	Ast mm	3,370	3,455	3,465
4. 34	Aisle width for pallets 800 x 1,200 lengthways	Ast mm	3,190	3,275	3,285
4. 35	Turning radius	Wa mm	1,685	1,770	1,780
4. 36	Smallest pivot point distance	mm	-	-	-

Performance Data

5. 1	Travel speed, loaded / unloaded	(48V) km/h	16 / 17	16 / 17	16 / 17
		(36V) km/h	15 / 16	15 / 16	15 / 16
5. 2	Lift speed, loaded / unloaded	(48V) mm/sec	410 / 600	410 / 600	410 / 600
		(36V) mm/sec	330 / 500	330 / 500	330 / 500
5. 3	Lowering speed, loaded / unloaded	mm/sec	500 / 450	500 / 450	500 / 450
5. 5	Drawbar pull, S2 30 min	(loaded) N	-	-	-
		(unloaded) N	-	-	-
5. 6	Max. drawbar pull, S2 5 min	(loaded) N	15,102	15,190	14,367
		(unloaded) N	14,759	14,710	14,043
5. 7	Gradient performance, S2 3 min	(loaded) %	-	-	-
		(unloaded) %	-	-	-
5. 8	Max. gradient performance, S2 5 min	(loaded) %	29.5	27.5	24.5
5. 10	Service brake	-	Hydraulic	Hydraulic	Hydraulic

E - Motor

6. 1	Drive motor rating S2 60 min	(48 V / 36 V) kW	4.4 / 3.5	4.4 / 3.5	4.4 / 3.5
6. 2	Pump motor rating at S3 - 15 %	(48 V / 36 V) kW	15.8 / 9.9	15.8 / 9.9	15.8 / 9.9
6. 4	Battery voltage, nominal capacity K5	(48 V / 36 V) Ah	48 / 505	48 / 585	48 / 585
6. 5	Battery weight (min)	kg (lb)	710	835	835
	Battery dimensions L / W /H	mm (in)	990 / 545 / 636	990 / 630 / 636	990 / 630 / 636

Other Details

8.1	Type of drive control		AC	AC	AC

- 22/25/30/32B-7, 22/25/30BHA-7 Model intro.

- ZAPI AC Dual AC2 drive controller (48/80V).
- ZAPI AC 2 Flash inverter (Hydr.) (48/80V).
- 2 x Sauer Danfoss drive motor . (7,8Kw).
- 1 x Sauer Danfoss Hydr. motor. (18/20Kw)
- MS Precision transmissions + wet brake
- Calibration through calibrator or display.
- 3 user modes selectable (H, N, E).
- Travel speed 17/18 – 18/19 km/h.
- Standard integrated mast profiles.
- Fingertip control available as option.
- Battery side loading available on 22>32B-7 (option).

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Identification

1.1	Manufacturer				
1.2	Type	22B-7	25B-7	30B-7	32B-7
1.3	Drive : electric (battery or mains), diesel, petrol, fuel gas, manual	Electric	Electric	Electric	Electric
1.4	Type of operation : hand, pedestrian, standing, seated, order - picker	Seated	Seated	Seated	Seated
1.5	Load capacity (standard) Q kg	2,200	2,500	3,000	3,200
1.6	Load center distance c mm	500	500	500	500
1.8	Load distance, center of drive axle to forks x mm	470	470	473	473
1.9	Wheelbase y mm	1,400	1,400	1,560	1,560

Weights

2.1	Service weight kg	3,940	4,290	4,660	4,856
2.2	Axle loading, loaded front / rear kg	5,451 / 689	5,684 / 896	6,701 / 959	7,015 / 1041
2.3	Axle loading, unloaded front / rear kg	1,727 / 2,213	1,662 / 2,628	1,830 / 2,830	1,819 / 3,037

Wheels, Chassis

3.1	Tires : solid rubber (V), superelastic (SE), pneumatic (P), polyurethane (PE)	SE, P	SE, P	SE, P	SE, P
3.2	Tires size, front (Φ x width)	23 x 9 - 10	23 x 9 - 10	23 x 9 - 10	23 x 9 - 10
3.3	Tires size, rear (Φ x width)	18 x 7 - 8	18 x 7 - 8	18 x 7 - 8	18 x 7 - 8
3.5	Wheels, number front / rear (x = driven wheels)	2 x / 2	2 x / 2	2 x / 2	2 x / 2
3.6	Track width, front mm	993	993	993	993
3.7	Track width, rear mm	980	980	980	980

Basic Dimensions

4.1	Mast / fork carriage tilt forward / backward (α/β) degrees	6 / 10	6 / 10	6 / 10	6 / 10
4.2	Lowered mast height h1 mm	2,152	2,152	2,152	2152
4.3	Free lift h2 mm	115	115	115	115
4.4	Lift height h3 mm	3,300	3,300	3,300	3,200
4.5	Extended mast height h4 mm	4,485	4,485	4,485	4,385
4.7	Overhead load guard (cab) height h5 mm	2,220	2,220	2,230	2,230
4.8	Seat height / Standing height h7 mm	1,180	1,180	1,180	1,180
4.12	Coupling height h10 mm	325	325	325	325
4.19	Overall length l1 mm	3,320	3,375	3,592	3,612
4.20	Length to face of forks l2 mm	2,270	2,325	2,542	2,562
4.21	Overall width b1 mm	1,200	1,200	1,200	1,200
4.22	Fork dimensions S x E x L mm	45 x 100 x 1,050		45 x 125 x 1,050	
4.23	Fork carriage ISO 2328, class / type A, B	II / A	II / A	III / A	III / A
4.24	Fork carriage width b3 mm	1,022	1,022	1,037	1,037
4.31	Ground clearance, loaded, under mast m1 mm	107	107	107	107
4.32	Ground clearance, centre of wheelbase m2 mm	130	130	130	130
4.33	Aisle width for pallets 1000 x 1200 crossways (LxW) Ast mm	3,560	3,595	3,800	3,820
4.34	Aisle width for pallets 800 x 1200 length ways (WxL) Ast mm	3,360	3,395	3,600	3,620
4.35	Turning radius Wa mm	1,865	1,900	2,120	2,120
4.36	Smallest pivot point distance mm	-	-	-	-

Performance Data

5.1	Travel speed, loaded / unloaded 48 V km/h	17 / 18	17 / 18	17 / 18	17 / 18
	36V	-	-	-	-
5.2	Lift speed, loaded / unloaded 48 V mm/sec	410 / 610	410 / 610	340 / 500	330 / 500
	36V	-	-	-	-
5.3	Lowering speed, loaded / unloaded mm/sec	500 / 450	500 / 450	500 / 450	500 / 450
5.5	Drawbar pull, loaded / unloaded S2 60 min N	-	-	-	-
5.6	Max. drawbar pull, loaded / unloaded S2 5 min N	18,088 / 17,774	18,098 / 17,677	17,972 / 17,664	17,985 / 17,615
5.7	Gradient performance, loaded / unloaded S2 30 min %	-	-	-	-
5.8	Max. gradient performance, loaded / unloaded S2 5 min %	31 / 23.4	27.8 / 21.3	24.1 / 22.2	23.0 / 22.2
5.9	Acceleration time, loaded / unloaded	-	-	-	-
5.10	Service brake	Hydraulic	Hydraulic	Hydraulic	Hydraulic

E - Motor

6.1	Drive motor rating S2 60 min 48 V kW	7.8 x 2	7.8 x 2	7.8 x 2	7.8 x 2
	36V	-	-	-	-
6.2	Pump motor rating at S3 - 15 % 48 V kW	18	18	18	18
	36V	-	-	-	-
6.4	Battery voltage, nominal capacity K5 48 V V / Ah	660	715	740	740
	36V	-	-	-	-
6.5	Battery weight (min) kg	1,040	1,100	1,270	1,270
	Battery compartment dimensions L / W / H mm	1,066 / 796 / 537		1,066 / 990 / 537	
6.6	Type of drive control	AC	AC	AC	AC

Identification

1.1	Manufacturer	HYUNDAI		
1.2	Type	22BHA-7	25BHA-7	30BHA-7
1.3	Drive : electric (battery or mains), diesel, petrol, fuel gas, manual	Electric	Electric	Electric
1.4	Type of operation : hand, pedestrian, standing, seated, order - picker	Seated	Seated	Seated
1.5	Load capacity (standard) Q kg	2200	2500	3000
1.6	Load center distance c mm	500	500	500
1.8	Load distance, center of drive axle to forks x mm	470	470	473
1.9	Wheelbase y mm	1575	1575	1719

Weights

2.1	Service weight kg	4194	4434	4895
2.2	Axle loading, loaded front / rear kg	5721 / 673	6172 / 762	7081 / 814
2.3	Axle loading, unloaded front / rear kg	2166 / 2028	2133 / 2301	2383 / 2512

Wheels, Chassis

3.1	Tires : solid rubber (V), superelastic (SE), pneumatic (P), polyurethane (PE)	SE, P	SE, P	SE, P
3.2	Tires size, front (Φ x width)	23 x 9 - 10	23 x 9 - 10	23 x 9 - 10
3.3	Tires size, rear (Φ x width)	18 x 7 - 8	18 x 7 - 8	18 x 7 - 8
3.5	Wheels, number front / rear (x = driven wheels)	2 x /2	2 x /2	2 x /2
3.6	Track width, front mm	993	993	993
3.7	Track width, rear mm	980	980	980

Basic Dimensions

4.1	Mast / fork carriage tilt forward / backward (α/β) degrees	6 / 8	6 / 8	6 / 8
4.2	Lowered mast height h1 mm	2152	2152	2152
4.3	Free lift h2 mm	115	115	115
4.4	Lift height h3 mm	3300	3300	3300
4.5	Extended mast height h4 mm	4485	4485	4485
4.7	Overhead load guard (cab) height h5 mm	2150	2150	2150
4.8	Seat height / Standing height h7 mm	1086	1086	1086
4.12	Coupling height h10 mm	400	400	400
4.19	Overall length l1 mm	3407	3472	3619
4.20	Length to face of forks l2 mm	2357	2422	2569
4.21	Overall width b1 mm	1200	1200	1200
4.22	Fork dimensions LxWxT S x E x L mm	45 x 100 x 1050	45 x 100 x 1050	45 x 125 x 1050
4.23	Fork carriage ISO 2328, class / type A, B	II / A	II / A	III / A
4.24	Fork carriage width b3 mm	1022	1022	1037
4.31	Ground clearance, loaded, under mast m1 mm	107	107	107
4.32	Ground clearance, centre of wheelbase m2 mm	125	125	125
4.33	Aisle width for pallets 1000 x 1200 crossways (LxW) Ast mm	3650	3710	3840
4.34	Aisle width for pallets 800 x 1200 length ways (WxL) Ast mm	3450	3510	3640
4.35	Turning radius Wa mm	1970	2030	2170
4.36	Smallest pivot point distance mm	-	-	-

Performance Data

5.1	Travel speed, loaded / unloaded (80 V) km/h	18 / 19	18 / 19	18 / 19
5.2	Lift speed, loaded / unloaded (80 V) mm/sec	420 / 500	410 / 500	340 / 500
5.3	Lowering speed, loaded / unloaded mm/sec	500 / 450	500 / 450	500 / 450
5.5	Drawbar pull, loaded / unloaded S2 60 min N	-	-	-
5.6	Max. drawbar pull, loaded / unloaded S2 5 min N	18159 / 17883	18157 / 17808	18157 / 17808
5.7	Gradient performance, loaded / unloaded S2 30 min %	-	-	-
5.8	Max. gradient performance, loaded / unloaded S2 5 min %	29 / 26	26 / 25	23 / 25
5.9	Acceleration time, loaded / unloaded	-	-	-
5.10	Service brake	Hydraulic	Hydraulic	Hydraulic

E - Motor

6.1	Drive motor rating S2 60 min (80V) kW	7.8 x 2	7.8 x 2	7.8 x 2
6.2	Pump motor rating at S3 - 15 % (80V) kW	20	20	20
6.4	Battery voltage, nominal capacity K5 (80V) V / Ah	500	500	600
6.5	Battery weight (min) kg	1470	1470	1780
	Battery compartment dimensions L / W / H mm	1032 / 714 / 790	1032 / 714 / 790	1032 / 858 / 790
6.6	Type of drive control	AC	AC	AC

- 35/40/45/50B-7 Model introduction.

- ZAPI AC Dual AC3 drive controller(80V).
- ZAPI AC 3 Flash inverter (Hydr.)(80V).
- 2 x Sauer Danfoss drive motor(8,1Kw).
- 1 x Sauer Danfoss Hydr. motor(23,8Kw)
- Pro-Mec transmissions + wet brake
- Calibration through calibrator or display.
- 3 user modes selectable (H, N, E).
- Travel speed 18 km/h.

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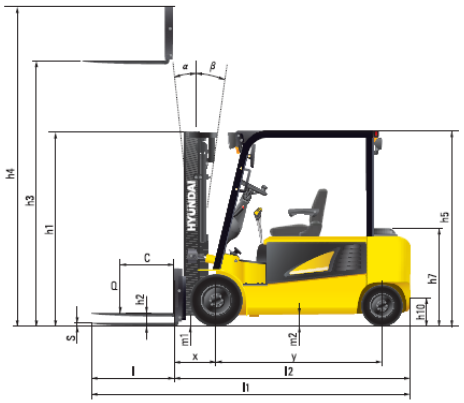

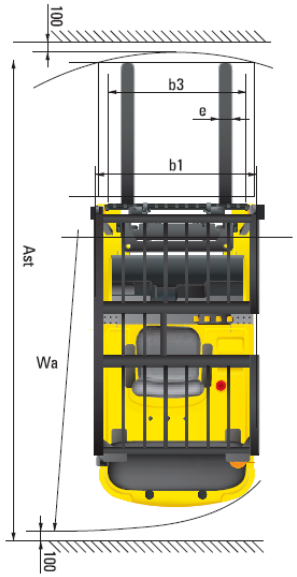

Identification

1. 1	Manufacturer		HYUNDAI			
1. 2	Type		35B-7	40B-7	45B-7	50B-7
1. 3	Drive : electric (battery or mains), diesel, petrol, fuel gas, manual		Electric	Electric	Electric	Electric
1. 4	Type of operation : hand, pedestrian, standing, seated, order - picker		Seated	Seated	Seated	Seated
1. 5	Load capacity (standard)	Q kg	3500	4000	4500	4990
1. 6	Load center distance	c mm	500	500	500	500
1. 8	Load distance, center of drive axle to forks	x mm	535	535	535	540
1. 9	Wheelbase	y mm	1855	2000	2000	2000

Weights

2. 1	Service weight	kg	6415	6655	7020	7520
2. 2	Axle loading, loaded front / rear	kg	8934 / 981	9580 / 1075	10348 / 1173	11213 / 1297
2. 3	Axle loading, unloaded front / rear	kg	3481 / 2934	3510 / 3145	3519 / 3501	3628 / 3892

Wheels, Chassis

3. 1	Tires : solid rubber (V), superelastic (SE), pneumatic (P), polyurethane (PE)		SE, P	SE, P	SE, P	SE, P
3. 2	Tires size, front (Φ x width)		250 - 15	250 - 15	250 - 15	28 x 12.5 - 15
3. 3	Tires size, rear (Φ x width)		21 x 8 - 9	21 x 8 - 9	21 x 8 - 9	21 x 8 - 9
3. 5	Wheels, number front / rear (x = driven wheels)		2 x / 2	2 x / 2	2 x / 2	2 x / 2
3. 6	Track width, front	mm	1141	1141	1141	1114
3. 7	Track width, rear	mm	1090	1090	1090	1090

Basic Dimensions

4. 1	Mast / fork carriage tilt forward / backward (α/β)	degrees	6 / 10	6 / 10	6 / 10	6 / 10
4. 2	Lowered mast height	h1 mm	2225	2225	2225	2230
4. 3	Free lift	h2 mm	120	120	120	120
4. 4	Lift height	h3 mm	3000	3000	3000	2900
4. 5	Extended mast height	h4 mm	4224	4224	4224	4146
4. 7	Overhead load guard (cab) height	h5 mm	2230	2320	2320	2320
4. 8	Seat height / Standing height	h7 mm	1166	1166	1166	1166
4. 12	Coupling height	h10 mm	460	460	460	460
4. 19	Overall length	l1 mm	3847	3992	4040	4100
4. 20	Length to face of forks	l2 mm	2777	2922	2970	3030
4. 21	Overall width	b1 mm	1370	1370	1370	1424
4. 22	Fork dimensions L x W x T	S x E x L mm	50 x 122 x 1070	50 x 122 x 1070	50 x 150 x 1070	50 x 150 x 1070
4. 23	Fork carriage ISO 2328, class / type A, B		III / A	III / A	III / A	IV / A
4. 24	Fork carriage width	b3 mm	1300	1300	1300	1300
4. 31	Ground clearance, loaded, under mast	m1 mm	160	160	160	165
4. 32	Ground clearance, centre of wheelbase	m2 mm	160	160	160	156
4. 33	Aisle width for pallets 1000 x 1200 crossways (L xW)	Ast mm	4195	4350	4395	4445
4. 34	Aisle width for pallets 800 x 1200 length ways (W x L)	Ast mm	3995	4150	4195	4245
4. 35	Turning radius	Wa mm	2460	2615	2660	2705
4. 36	Smallest pivot point distance	mm	-	-	-	-

Performance Data

5. 1	Travel speed, loaded / unloaded (80 V)	km/h	18 / 18	18 / 18	18 / 18	18 / 18
5. 2	Lift speed, loaded / unloaded (80 V)	mm/sec	380 / 500	380 / 500	330 / 500	320 / 450
5. 3	Lowering speed, loaded / unloaded	mm/sec	550 / 520	550 / 520	550 / 520	500 / 430
5. 5	Drawbar pull, loaded / unloaded S2 60 min	N	-	-	-	-
5. 6	Max. drawbar pull, loaded / unloaded S2 5 min	N	28931 / 29122	28185 / 29075	28662 / 29003	28558 / 28469
5. 7	Gradient performance, loaded / unloaded S2 30 min	%	-	-	-	-
5. 8	Max. gradient performance, loaded / unloaded S2 5 min	%	30 / 26	28 / 26	26 / 24	23 / 24
5. 9	Acceleration time, loaded / unloaded		-	-	-	-
5. 10	Service brake		Hydraulic	Hydraulic	Hydraulic	Hydraulic

E - Motor

6. 1	Drive motor rating S2 60 min (80V)	kW	8,1 x 2	8,1 x 2	8,1 x 2	8,1 x 2
6. 2	Pump motor rating at S3 - 15 % (80V)	kW	23,8	23,8	23,8	23,8
6. 4	Battery voltage, nominal capacity K5 (80V)	Ah	600	700	700	700
6. 5	Battery weight (min)	kg	1780	2095	2095	2095
	Battery compartment dimensions L / W / H	mm	1033 / 859 / 790	1033 / 859 / 790	1033 / 1004 / 790	1033 / 1004 / 790
6. 6	Type of drive control		AC	AC	AC	AC

Drive units and intergrated wet brake systems

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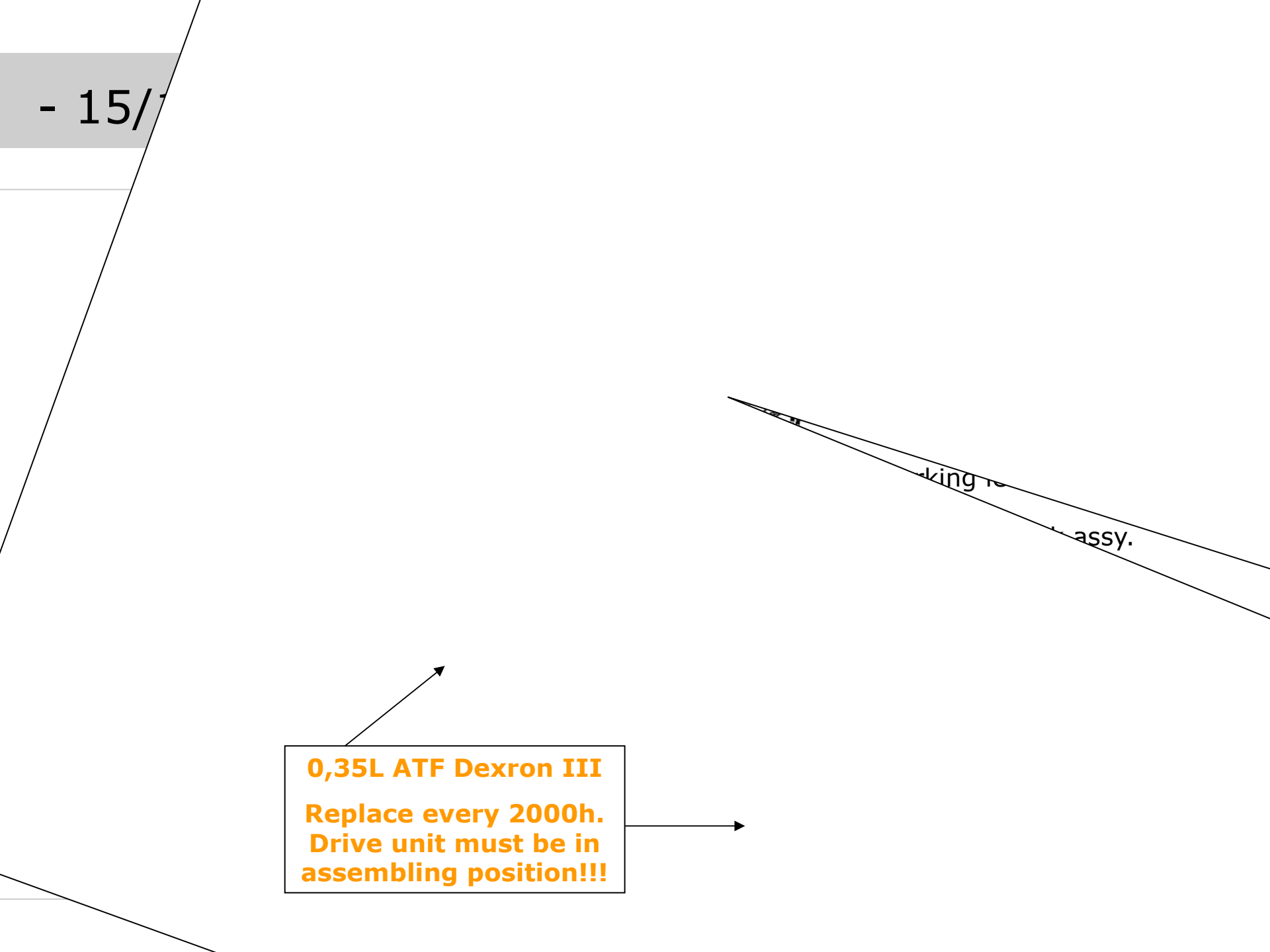
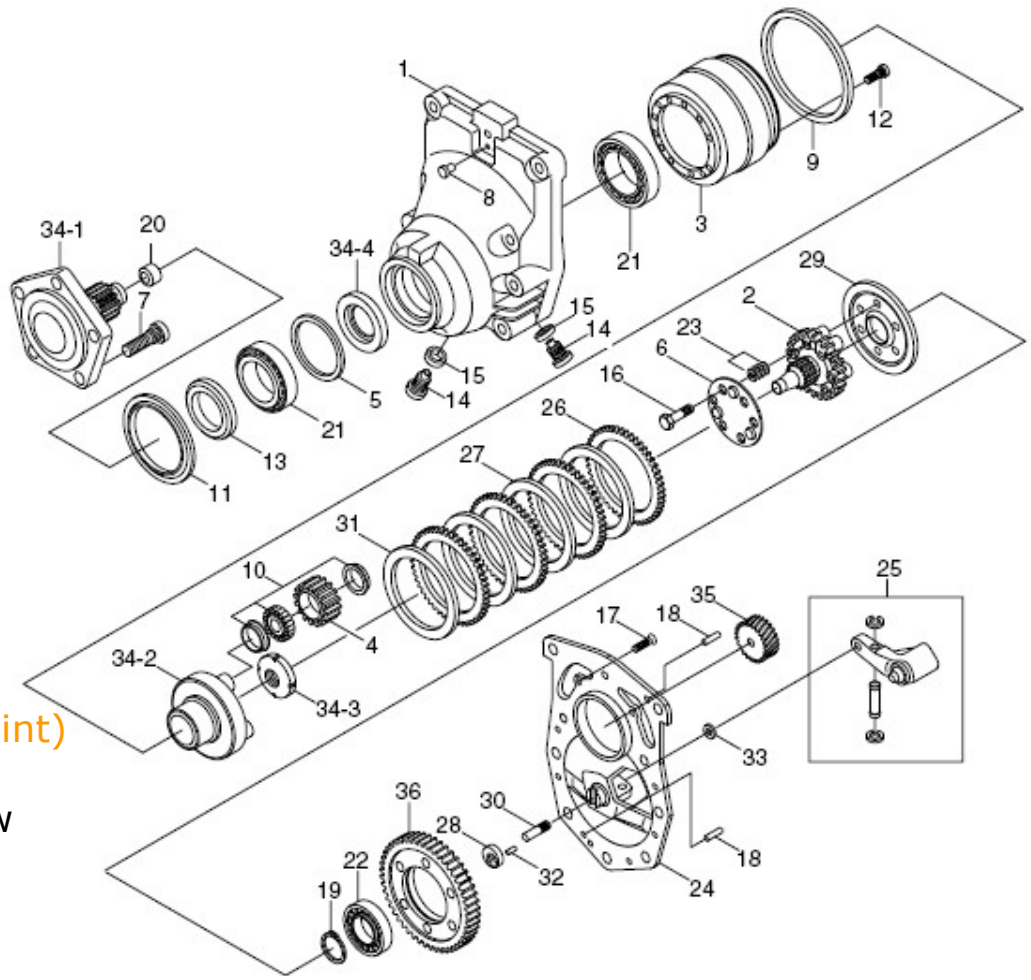
- 15/18/20BT-7, 16/18/20B-7 Drive Unit.

12


assy.
0,35L ATF Dexron III
Replace every 2000h.
Drive unit must be in
assembling position!!!

- 15/18/20BT-7, 16/18/20B-7 Drive Unit + Brake.

1 Housing
2 Disc carrier
3 Internal gear
4 Planet gear
5 Shim
6 Fixing plate
7 Wheel bolt
8 Breather filter
9 Fey ring
10 Roller bearing
11 Gamma ring
12 Socket screw
13 Nilos ring
14 Magnet plug (Oil level checkpoint)
15 Seal ring
16 Hexagon screw
17 Torax screw
18 Cylinder pin



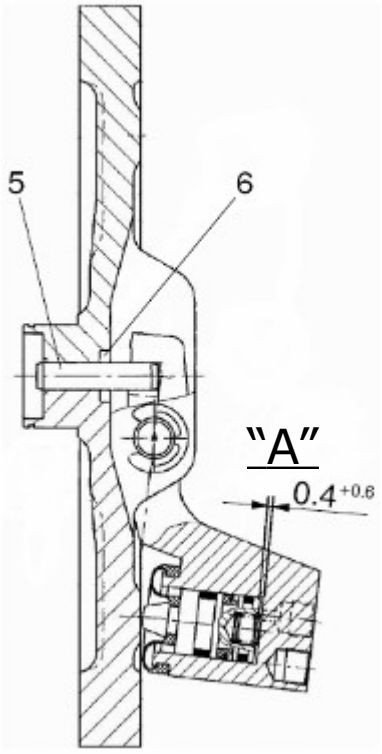
19 Circlips
20 Needle ring
21 Taper roller bearing
22 Grooved ball bearing
23 Pressure spring
24 Housing cover
25 Brake lever complete
26 Outer clutch disc
27 Inner clutch disc
28 Axial bearing
29 Pressure disc
30 Pressure pin
31 Pressure disc
32 Cylinder pin
33 Shaft seal
34 Planet carrier assy.
34-1 Wheel shaft
34-2 Planet carrier
34-3 Slotted nut
34-4 Shaft seal
35 Pinion
36 Spur gear

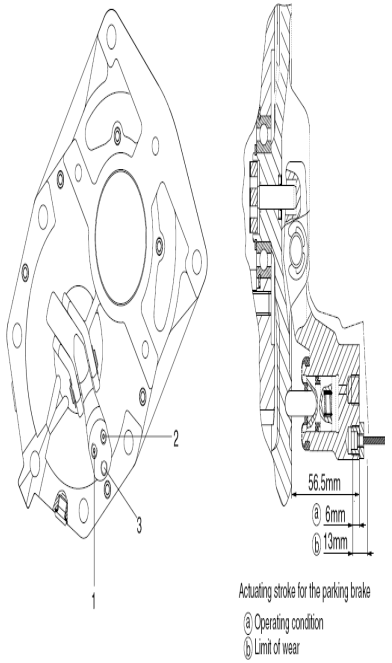
14

For detailed disassembling, assembling and adjustment info: check service manual!!!

- 15/18/20BT-7, 16/18/20B-7 Brake Adjustment.

- Adjusting dimension "A" for the brake lever is between 0.4 ~ 1.0mm.
-The adjusting dimension has to be checked with a dial gauge.
- For this purpose position the feeler of the dial gauge on the brake lever in the specified measuring point range. Press the brake lever against the cover and read the deflection on the dial gauge.
- If the adjusting dimension should not be within the specified range, it has to be obtained and set with the pressure pin(5).
- Several pressure pins can be selected.
- If the pressure pin has to be replaced the brake lever has to be removed again.
- Only then it is possible to replace the pressure pin from the bore of the cover.
- When installing the pressure pin do not damage the radial shaft seal. First wet the sealing lips of the radial shaft seal(6) slightly with grease before installing the new pin.
- After reinstallation the brake lever, recheck the adjusting dimension according to the procedure described above.





-Check free play of brake cylinder during every maintenance.

-If no play, check handbrake or pedal brake adjustment.

15

For detailed disassembling, assembling and adjustment info: check service manual!!!

- 22/25/30/32B-7, 22/25/30BHA-7 Drive Unit

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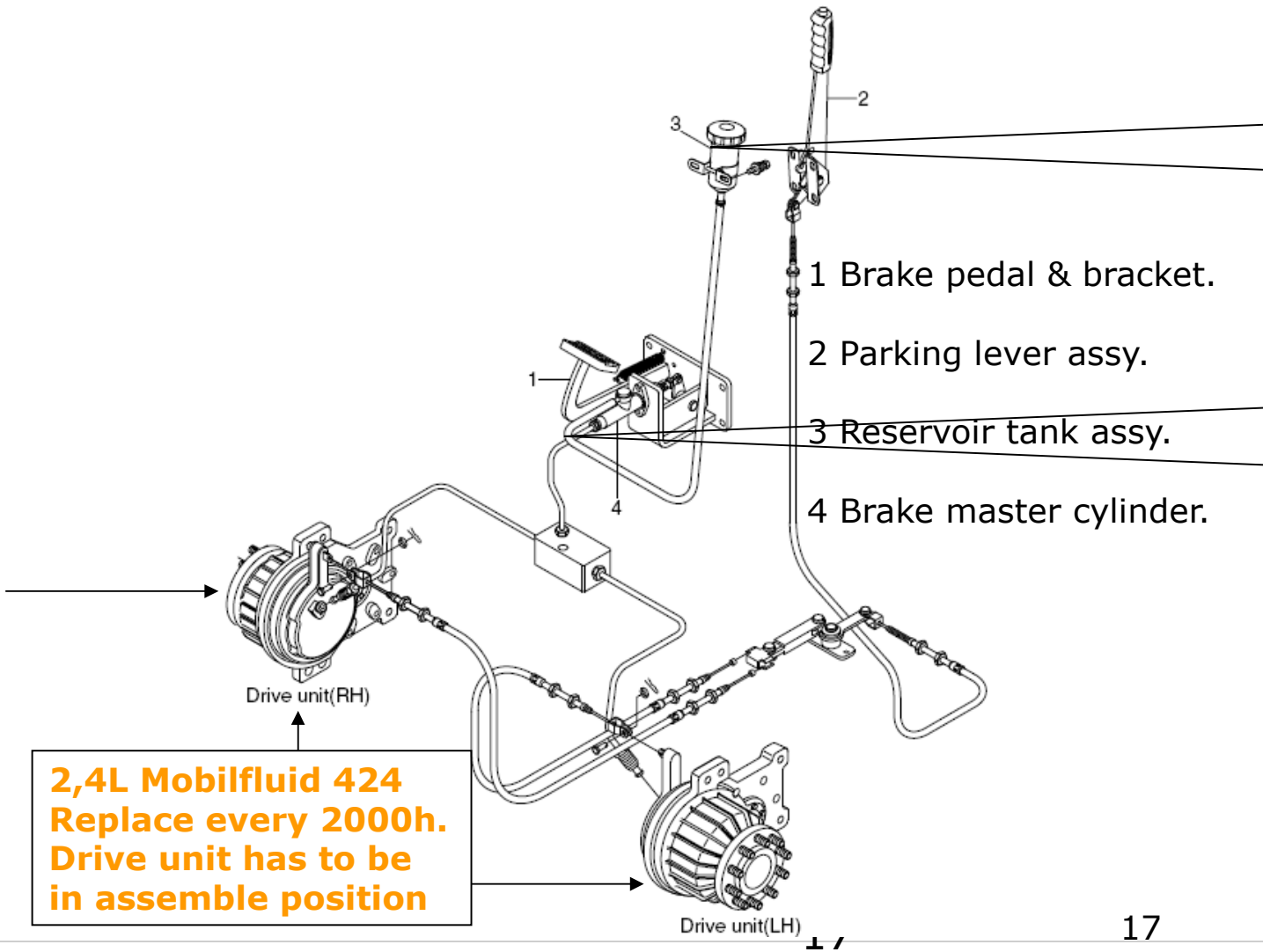
22/25/30/32B-7, 22/25/30BHA-7 Brake Structure.



1 Brake pedal & bracket.

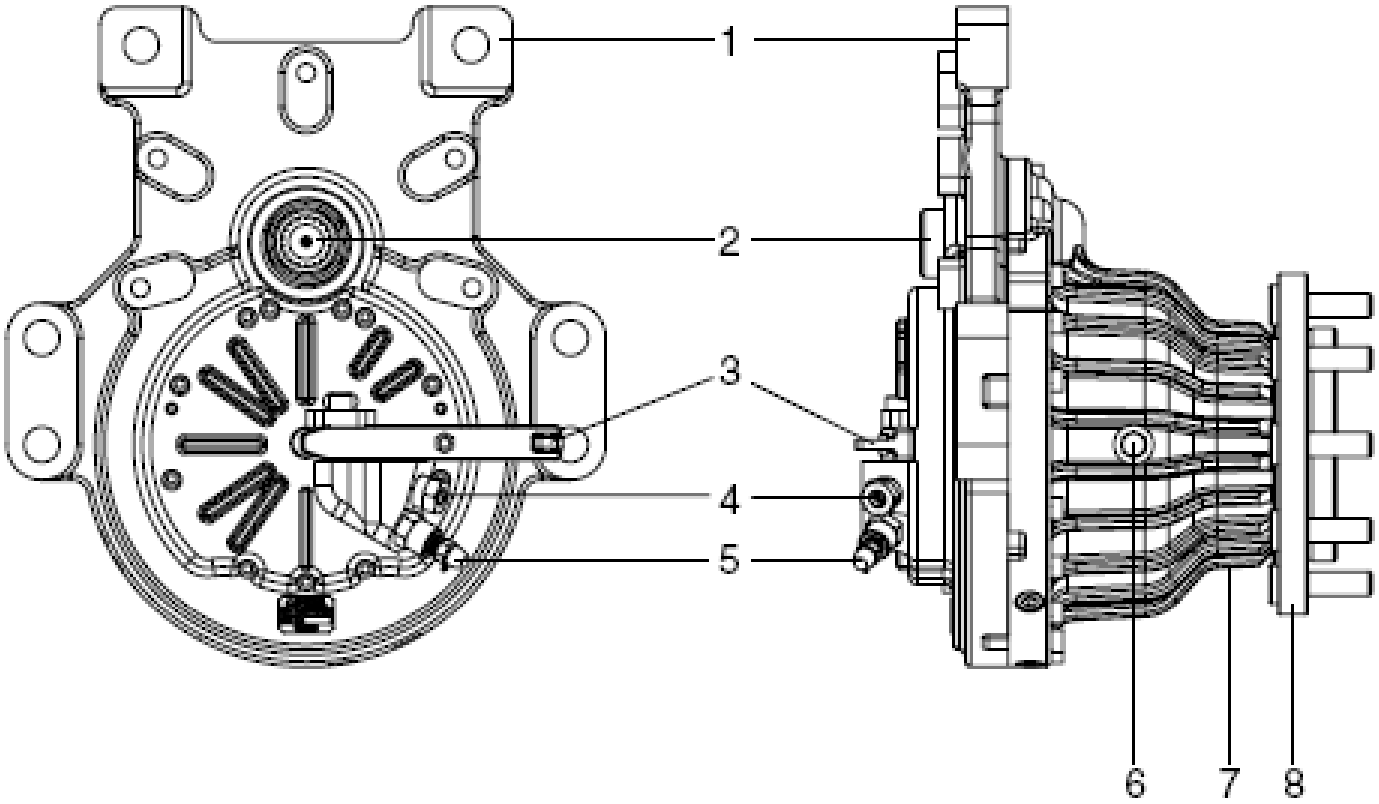
2 Parking lever assy.

3 Reservoir tank assy.

4 Brake master cylinder.

2,4L Mobilfluid 424
Replace every 2000h.
Drive unit has to be
in assemble position

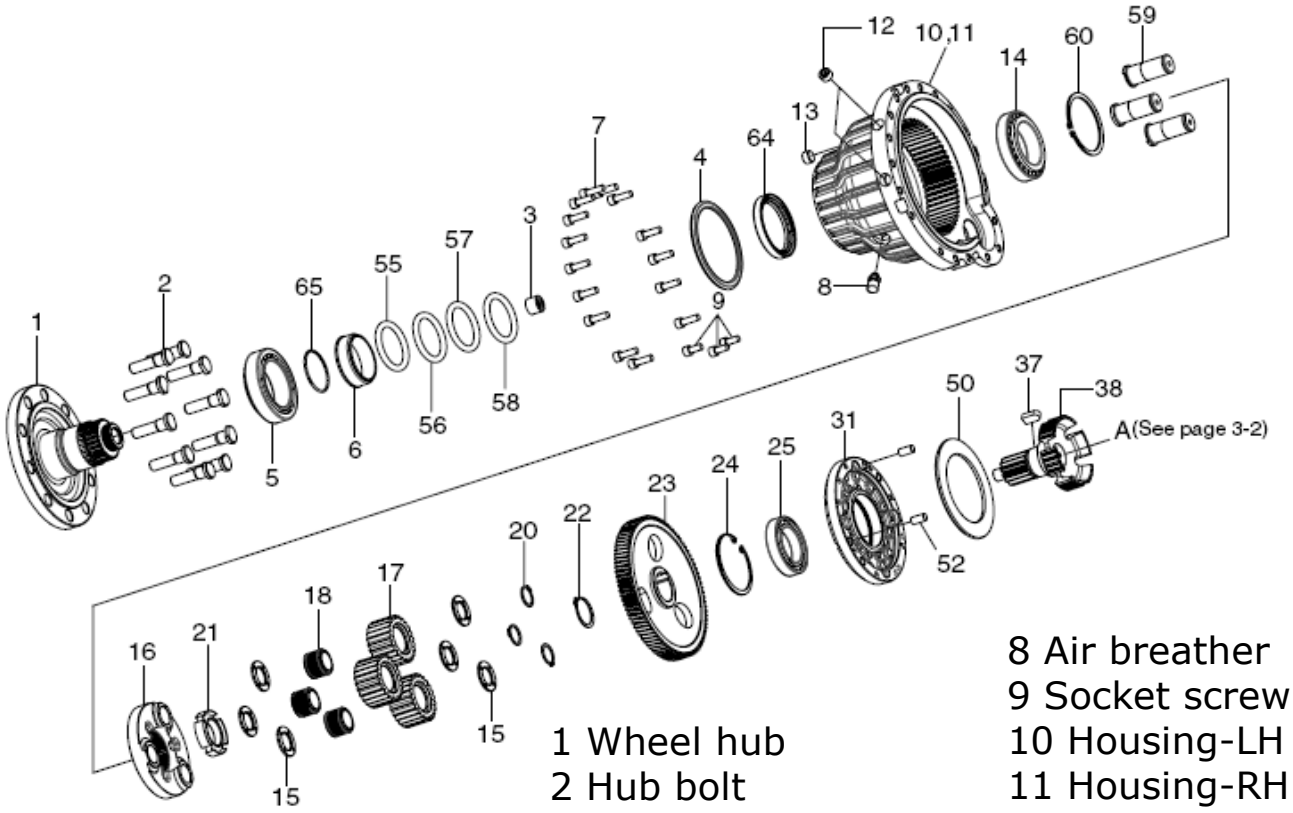
- 22/25/30/32B-7, 22/25/30BHA-7 Drive Unit.



1 Brake housing.
2 Drive gear (electro motor input).
3 Parking brake lever (adjustable).
4 Brake port (brake pipe input).
5 Bleeding valve.
6 Air breather.
7 Drive unit housing.
8 Wheel hub.

18

- 22/25/30/32B-7, 22/25/30BHA-7 Drive Unit.



1 Wheel hub
2 Hub bolt
3 Needle bearing
4 Gamma seal
5 Taper roller bearing
6 Spacer
7 Bolt

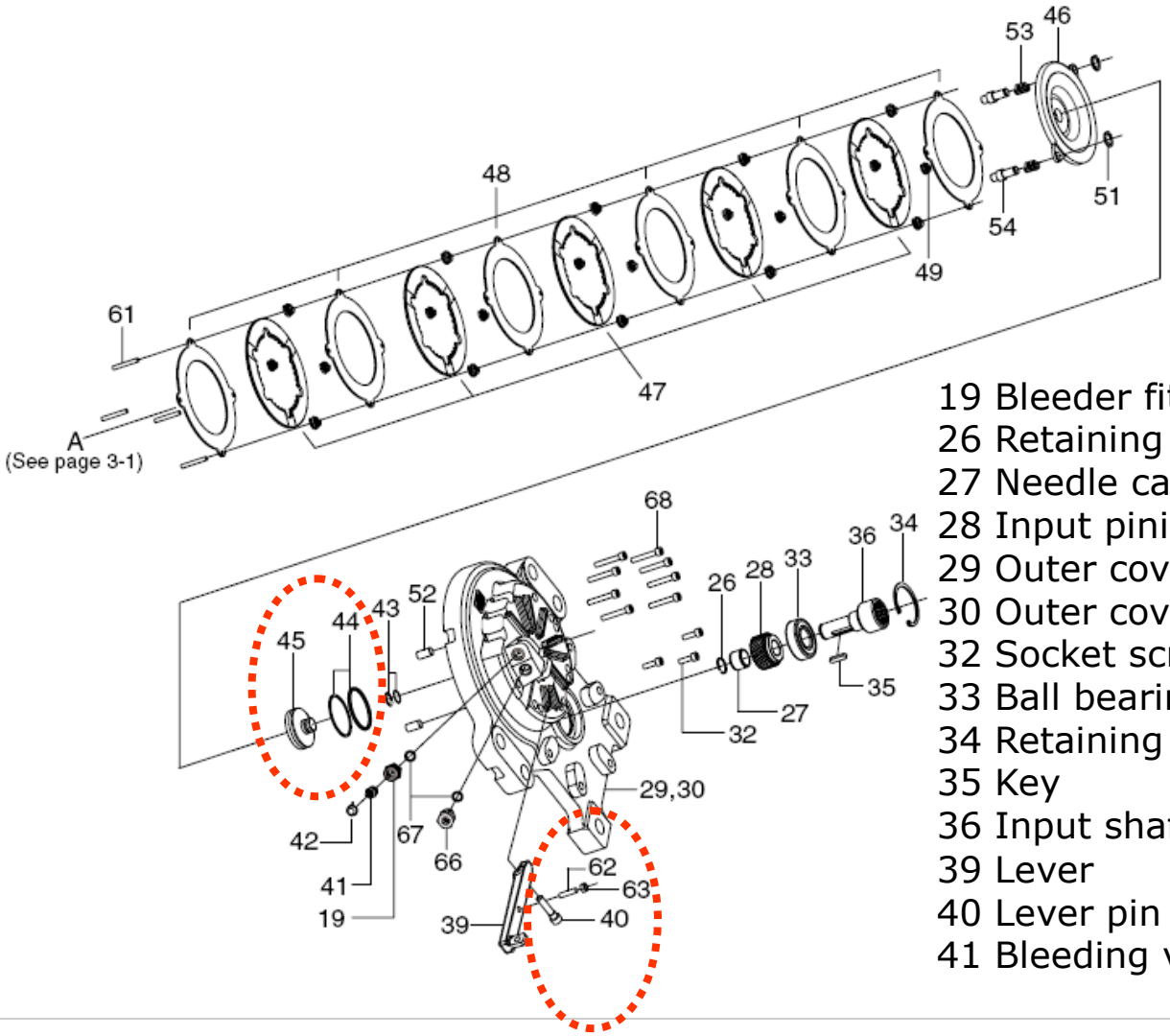
8 Air breather
9 Socket screw
10 Housing-LH
11 Housing-RH
12 Plug
13 Magnetic plug
14 Taper roller bearing
15 Thrust washer
16 Planet carrier

17 Planet gear
18 Needle bearing
20 Retaining ring
21 Lock nut
22 Retaining ring
23 Gear
24 Retaining ring
25 Ball bearing
31 Inner cover
37 Key
38 Sun pinion
50 Support disk
55 Shim
56 Shim
57 Shim
58 Shim
59 Carrier pin
60 Retaining ring
64 Oil seal
65 O-ring

19

For detailed disassembling, assembling and adjustment info: check service manual!!!

-22/25/30/32B-7, 22/25/30BHA-7 Drive/Brake Unit

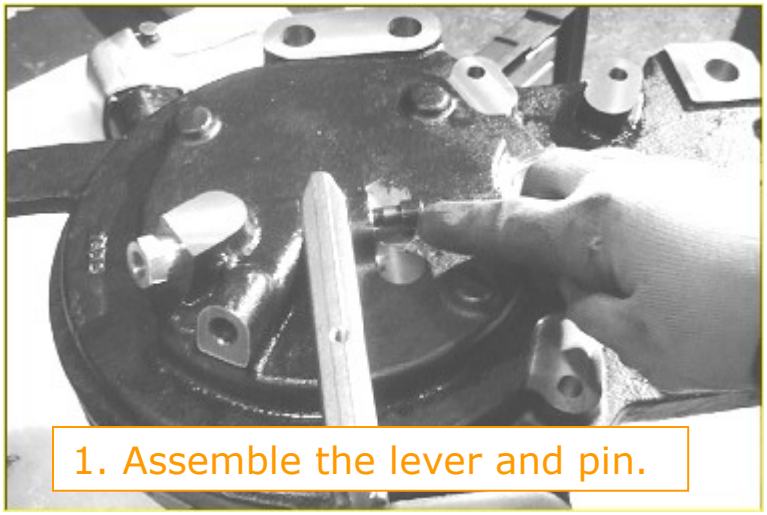


19 Bleeder fitting
26 Retaining ring
27 Needle cage
28 Input pinion
29 Outer cover-LH
30 Outer cover-RH
32 Socket screw
33 Ball bearing
34 Retaining ring
35 Key
36 Input shaft (motor)
39 Lever
40 Lever pin
41 Bleeding valve

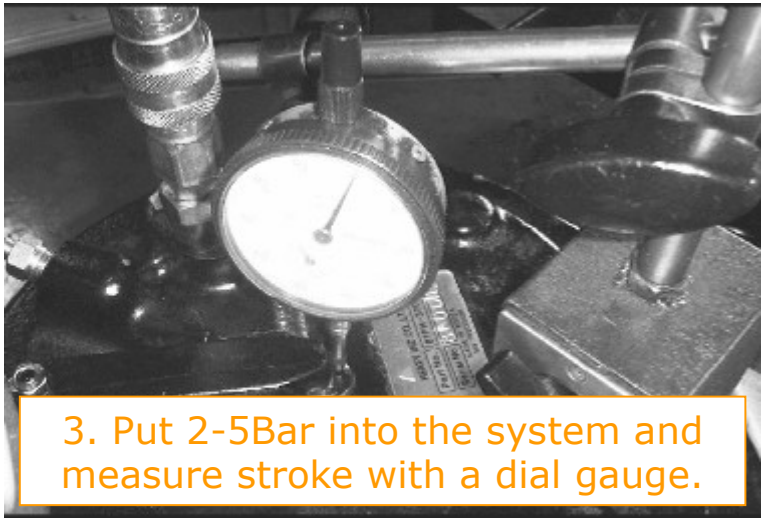
42 Bleeding valve cap
43 O-ring (Seal)
44 Step seal
45 Piston
46 Elastic disk
47 Friction disk
48 Steel disk
49 Cone spring
51 Retaining ring
52 Parallel pin
53 Spring
54 Stud
61 Parallel pin
62 Set screw
63 Nut
66 Brake plug
67 O-ring
68 Socket screw

20

22/25/30/32B-7, 22/25/30BHA-7 Brake adjustment



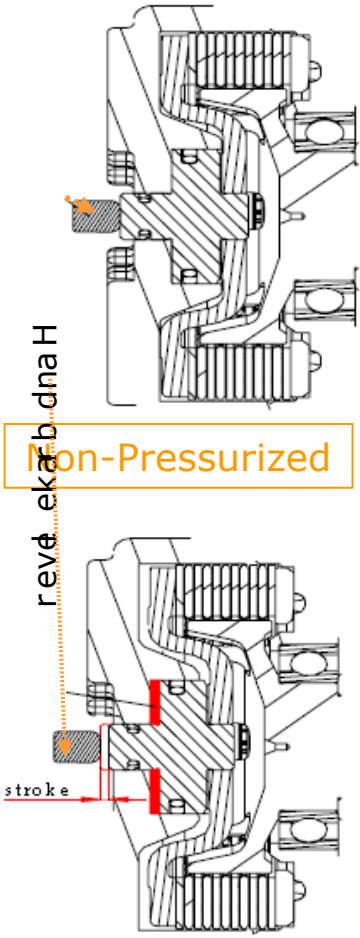
1. Assemble the lever and pin.



3. Put 2-5Bar into the system and measure stroke with a dial gauge.

2. Assemble an adapter (pump) to pressurized the brake system.

4. Set piston stoke (Play between handbrake lever and piston head) 1.2mm and tighten nut



Non-Pressurized

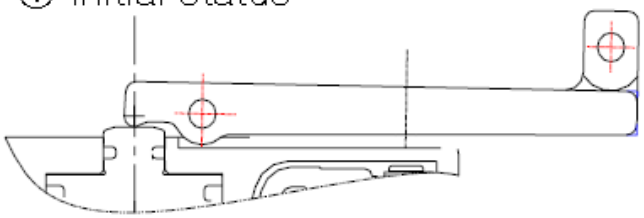
Pressurized

22/25/30/32B-7, 22/25/30BHA-7 Brake adjustment

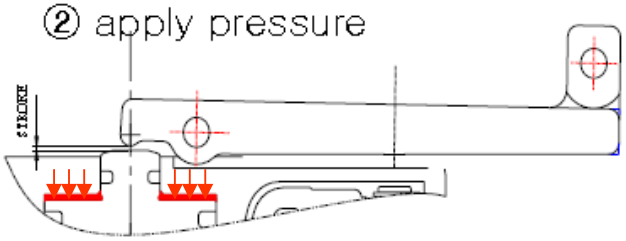
Handbrake released.

By external pump or pushing the brake pedal.

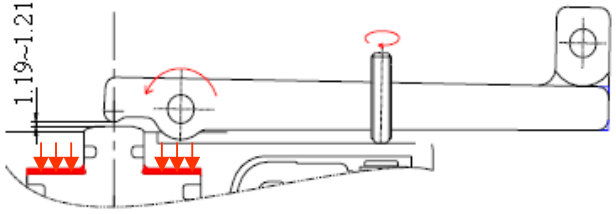
① initial status



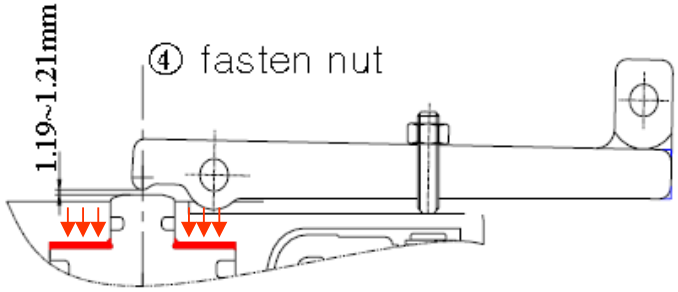
② apply pressure



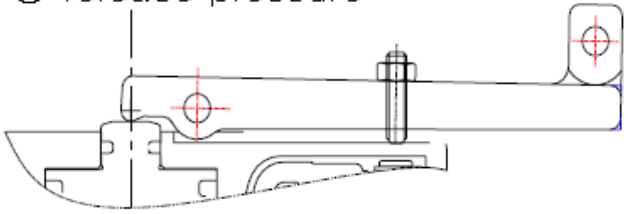
③ setting distance by screw

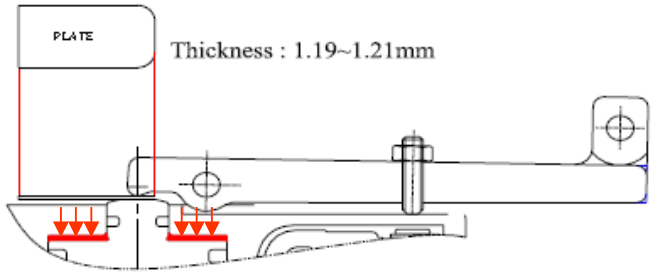


④ fasten nut



⑤ release pressure



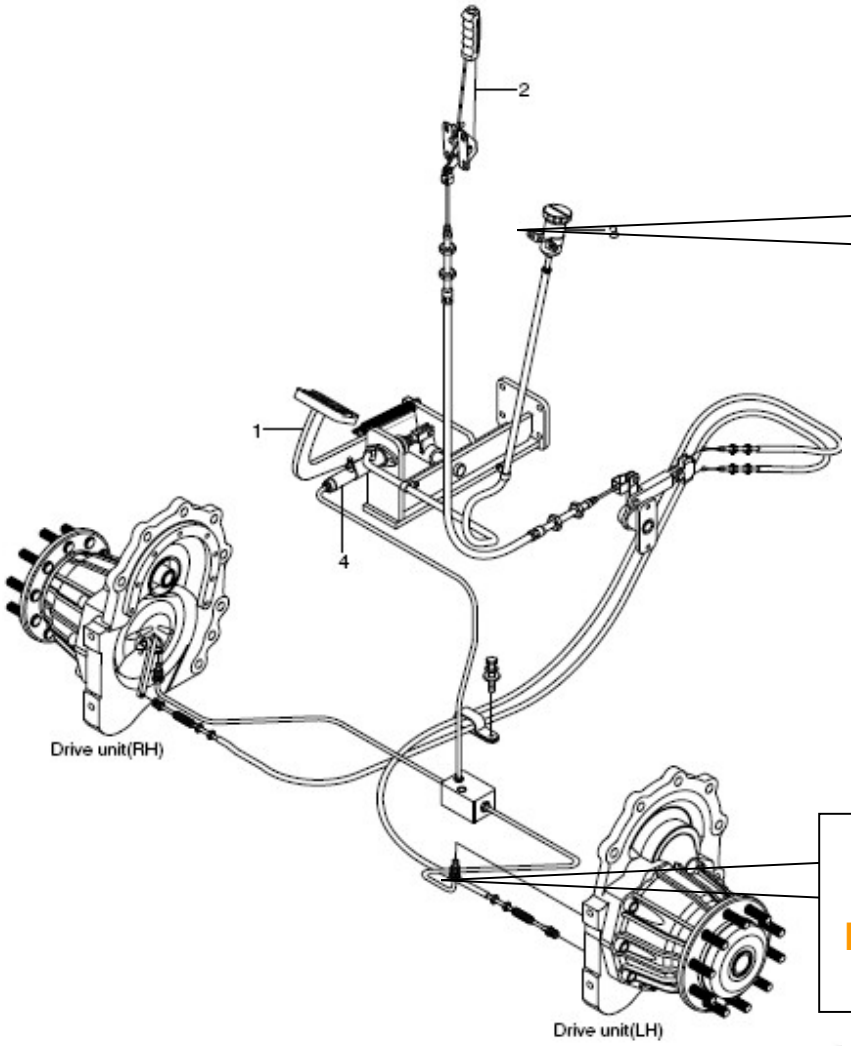


= Hydraulic pressure

22

- 35/40/45/50B-7 Drive Unit + Brake.

- 35/40/45/50B-7 Brake Structure.

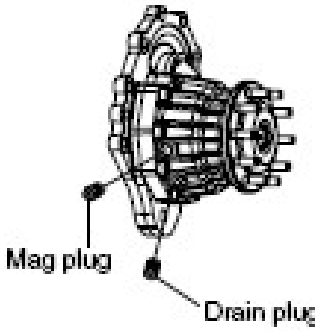


1 Brake pedal & bracket assy.

2 Parking lever assy.

3 ~~Reservoir tank assy.~~

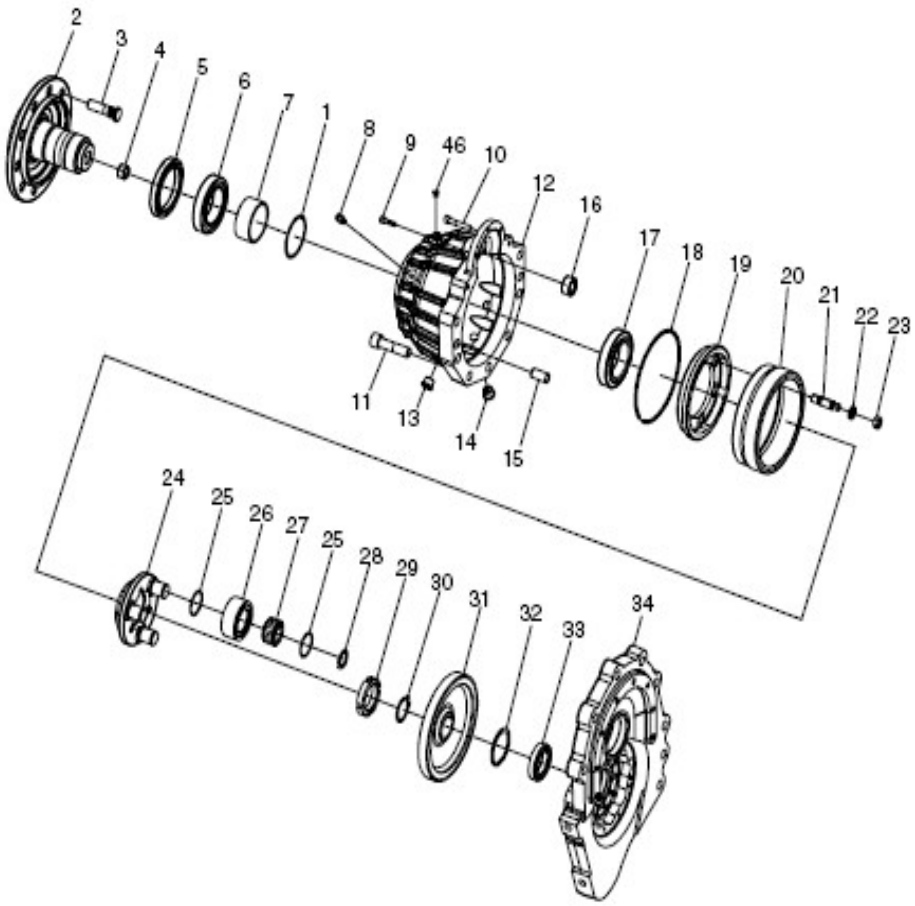
4 Brake master cylinder.



1,5L Mobilfluid 424
Replace every 2000h.
Drive unit has to be in assembling position

24

- 35/40/45/50B-7 Drive Unit + Brake.

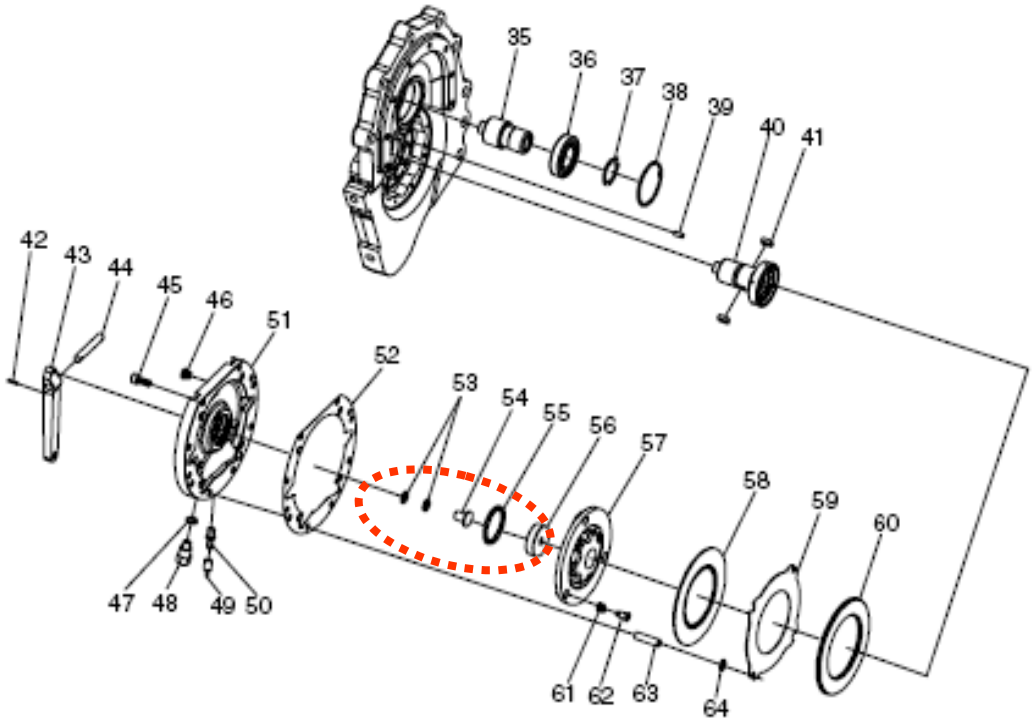


1 Spacer
2 Wheel hub
3 Wheel fixing screw
4 Needle cage
5 Shaft seal
6 Taper roller bearing
7 Spacer
8 Breather plug
9 Cap screw
10 Cap screw
11 Cap screw
12 Housing
13 Screw plug
14 Magnetic screw plug
15 Locking pin
16 Needle cage
17 Taper roller bearing
18 Retaining ring
19 Ring gear disc
20 Ring gear
21 Stud
22 Washer
23 Hexagon nut
24 Planet carrier
25 Retaining ring
26 Planet gear
27 Roller bearing
28 Retaining ring
29 Lock nut
30 Retaining ring
31 Helix gear
32 Retaining ring
33 Ball bearing
34 Cover

25

For detailed disassembling, assembling and adjustment info: check service manual!!!

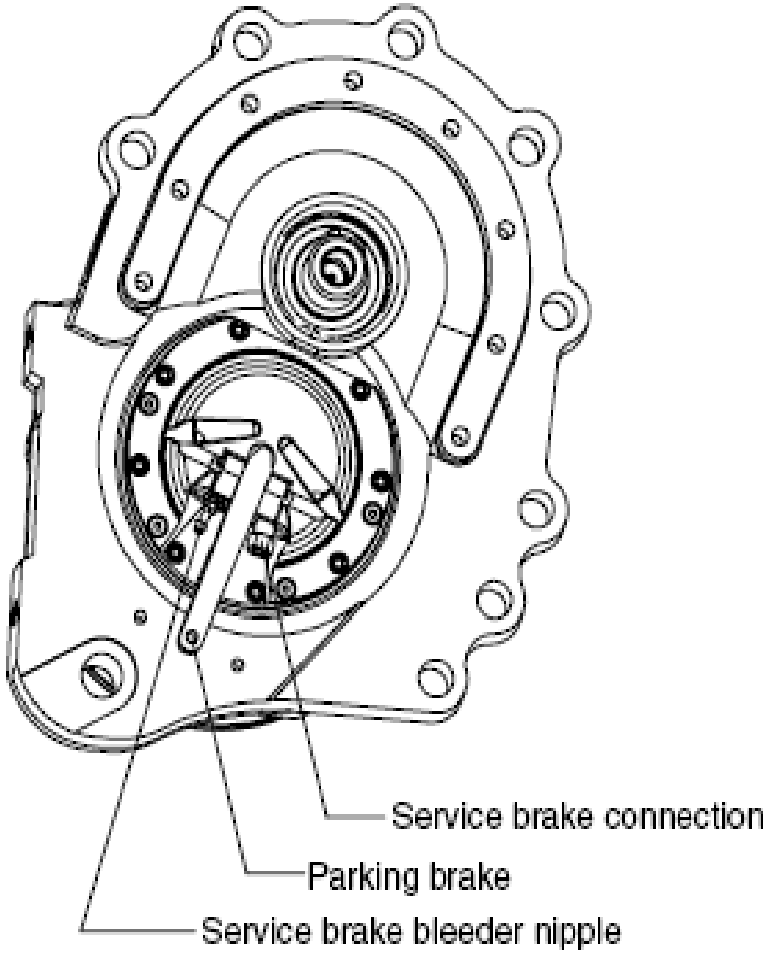
- 35/40/45/50B-7 Drive Unit + Brake.



35 Helix pinion
36 Ball bearing
37 Retaining ring
38 Retaining ring
39 Locking pin
40 Sun pinion
41 Feather key
42 Elastic pin
43 Lever
44 Pin
45 Cap screw
46 Screw plug
47 Washer
48 Connection
49 Bleeder nipple cap
50 Bleeder nipple
51 Brake housing
52 Seal
53 Piston seal
54 Piston
55 Step seal
56 Piston
57 Disk pusher
58 Friction disk
59 Steel disk
60 Support disk
61 Spring
62 Fixing screw
63 Locking pin
64 Spring

26

- 35/40/45/50B-7 Brake Adjustment.



- It's recommendable checking every **2000** working hours if the stroke of the brake piston (pos 54 on page 26) hasn't increased above 3.5mm.

- If so, it will be necessary to replace the brake disk pack.

- Follow next procedure in order to estimate the wear of the discs:

A. Disconnect the hand brake rod (cable).

B. Move the lever towards the brake piston (until it touches the topside of the piston pos 54).

C. Pull the lever strongly and measure the stroke at the end of the parking brake lever.

D. If the parking brake lever stroke is over 21mm the disc pack has to be replaced.

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General Brake and Drive Unit's Oil Quality Overview

Description	Model	Specification
Gear oil	15/18/20BT-7, 16/18/20B-7,	ATF DEXRON III
	22/25/30/32B-7,	Mobilfluid 424
	20/25/30/32BC-7	SAE 80W/90, SAE 75W/90(-35°C)
	35/40/45/50B-7	Mobilfluid 424
Hydraulic oil	All model	ISO VG46
Brake oil	22/25/30/32B-7,	Hydraulic oil SAE 10W(Azola ZS10)
	15/18/20BT-7, 16/18/20B-7, 20/25/30/32BC-7	DOT3, DOT4
	35/40/45/50B-7	
Grease	All model	NLGI No.2

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Hydraulic systems

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- 15/18/20BT-7, 16/18/20B-7 Hydraulics.

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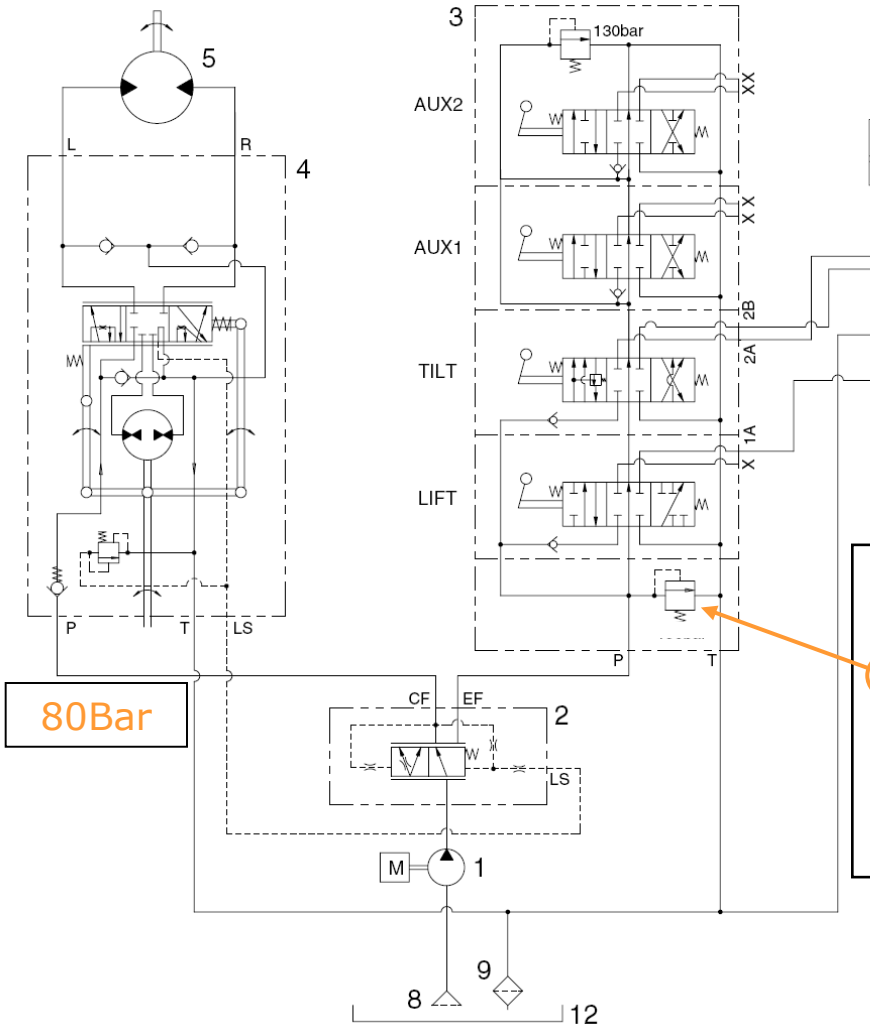
- 15/18/20BT-7 Hydraulic Diagram (Non OPSS).



- Steering: 80Bar
- Main: 15BT-7=160Bar
  18BT-7=180Bar
  20BT-7=190Bar
- Auxiliary: +/- 130Bar

1 Hydraulic gear pump

2 Priority valve

3 Main control valve

4 Steering unit

5 Steering hydraulic motor

6 Tilt cylinder

7 Lift cylinder

8 Suction strainer

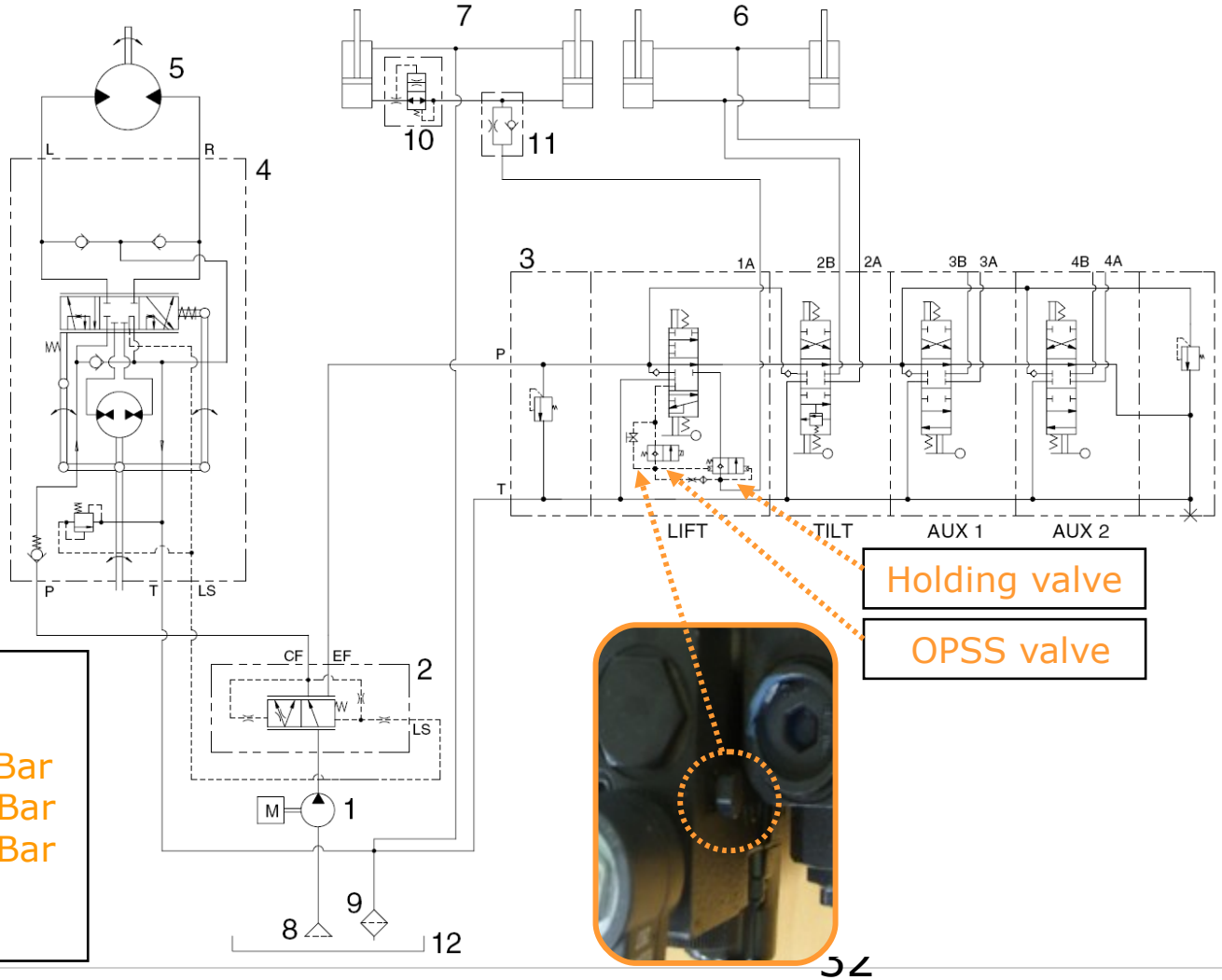
9 Return filter

10 Down safety valve

11 Down control valve

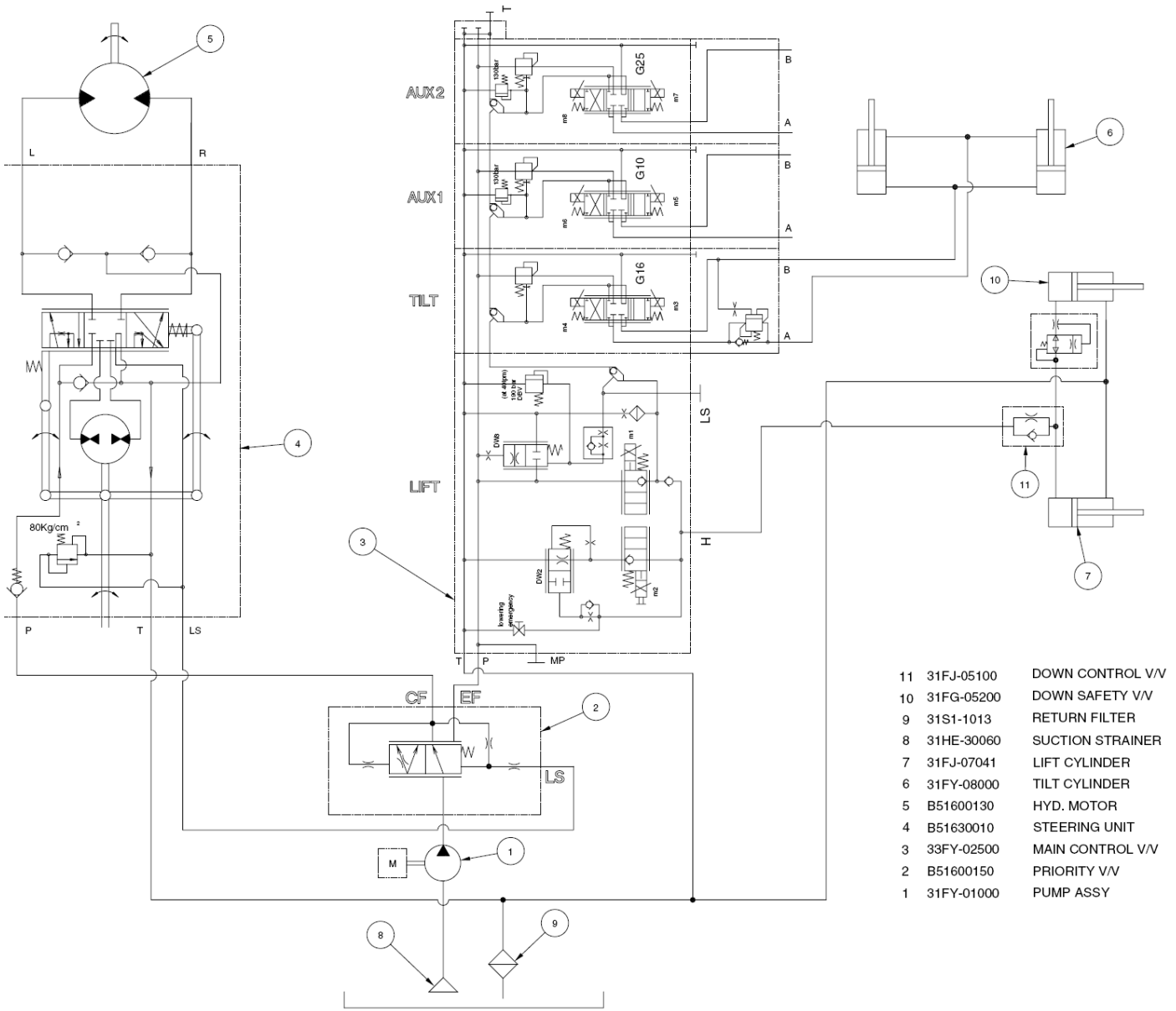
12 Hydro Tank.

- 15/18/20BT-7 Hydraulic Diagram (OPSS).



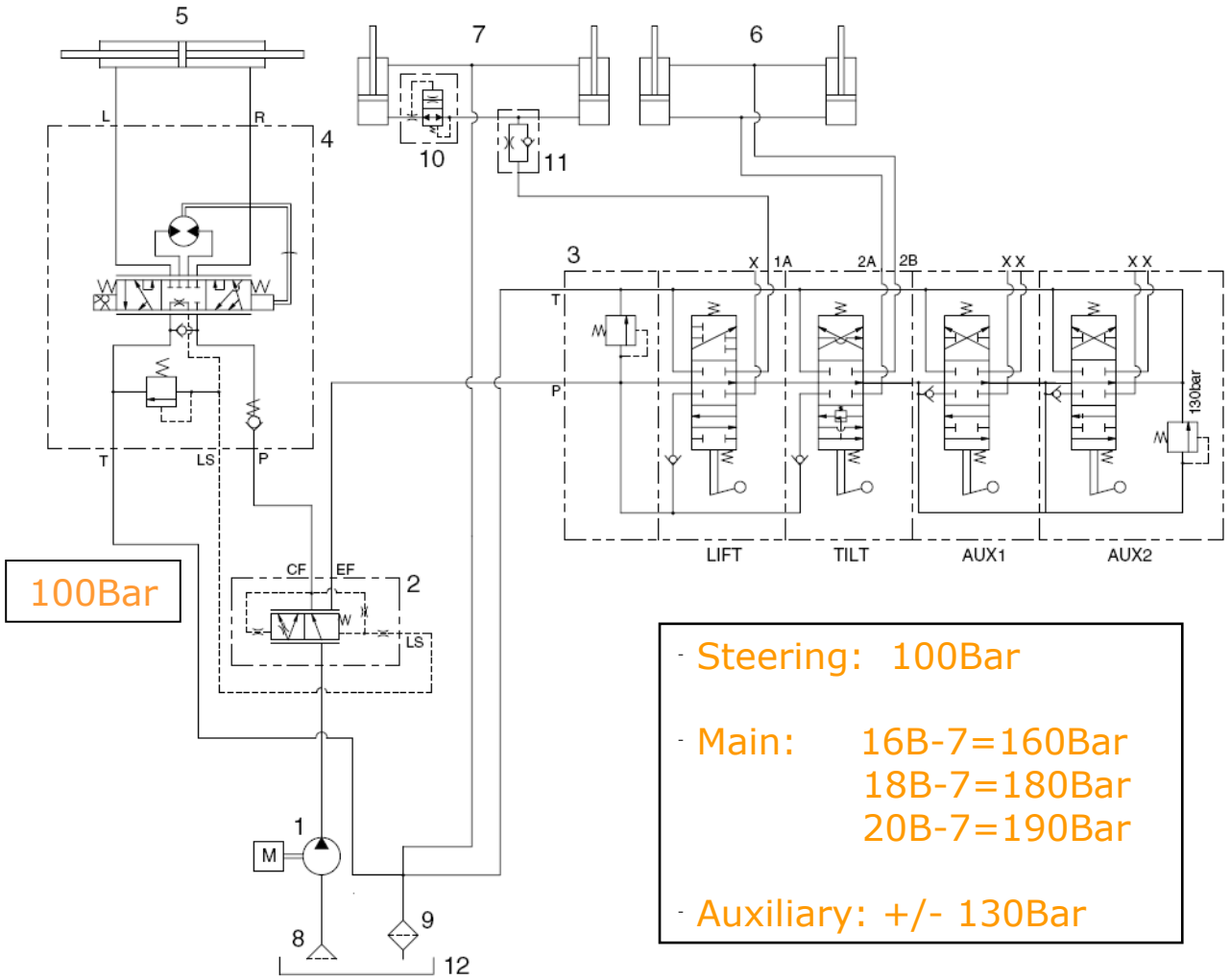
- Steering: 80Bar
- Main: 15BT-7=160Bar
  18BT-7=180Bar
  20BT-7=190Bar
- Auxiliary: +/- 130Bar

- 15/18/20BT-7 Hydraulic Diagram (OPSS+ fing).



11	31FJ-05100	DOWN CONTROL V/V
10	31FG-05200	DOWN SAFETY V/V
9	31S1-1013	RETURN FILTER
8	31HE-30060	SUCTION STRAINER
7	31FJ-07041	LIFT CYLINDER
6	31FY-08000	TILT CYLINDER
5	B51600130	HYD. MOTOR
4	B51630010	STEERING UNIT
3	33FY-02500	MAIN CONTROL V/V
2	B51600150	PRIORITY V/V
1	31FY-01000	PUMP ASSY

- 16/18/20B-7 Hydraulic Diagram (Non OPSS).



- Steering: 100Bar
- Main: 16B-7=160Bar
  18B-7=180Bar
  20B-7=190Bar
- Auxiliary: +/- 130Bar

1 Hydraulic gear pump

2 Priority valve

3 Main control valve

4 Steering unit

5 Steering cylinder

6 Tilt cylinder

7 Lift cylinder

8 Suction strainer

9 Return filter

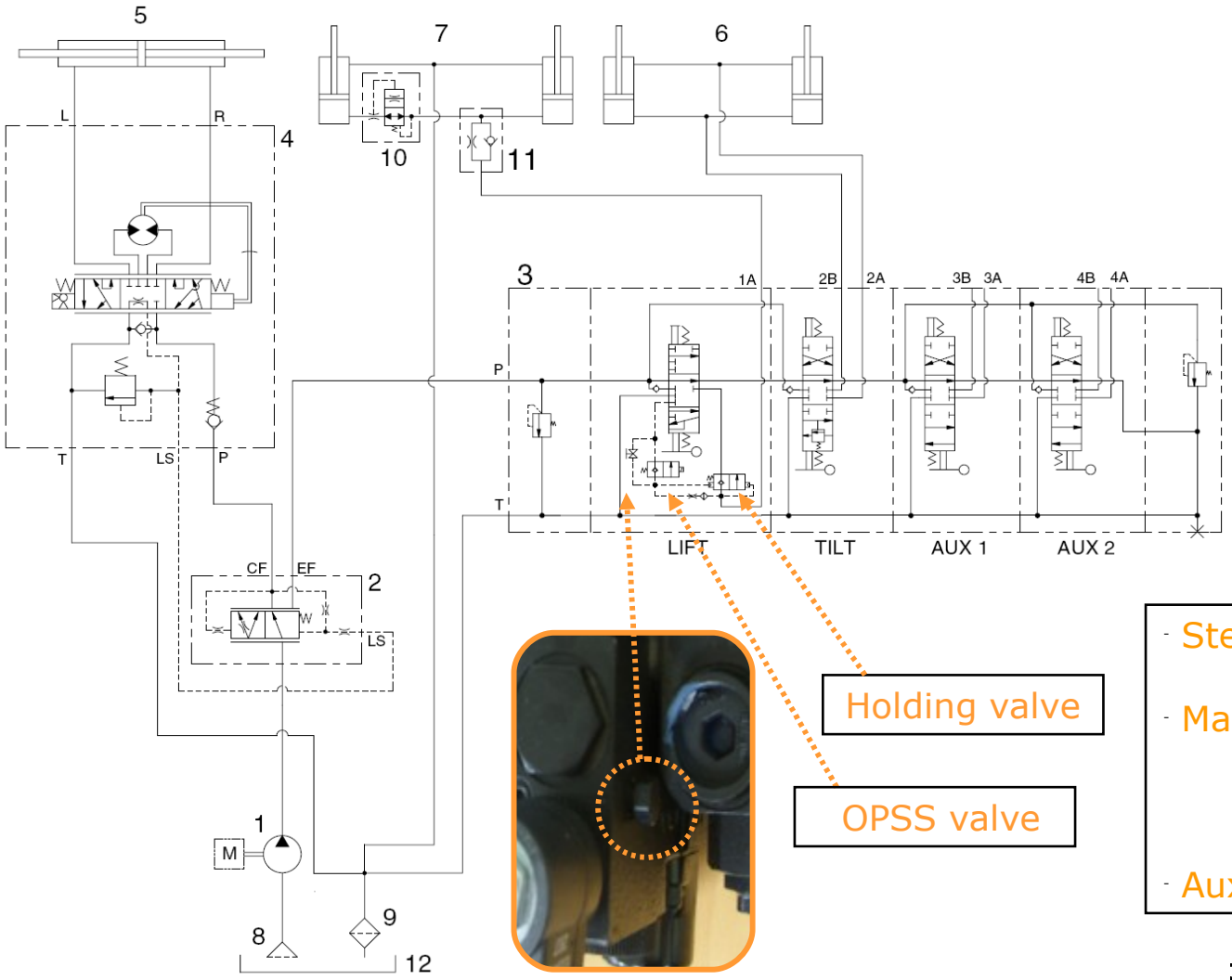
10 Down safety valve

11 Down control valve

12 Hydraulic oil tank

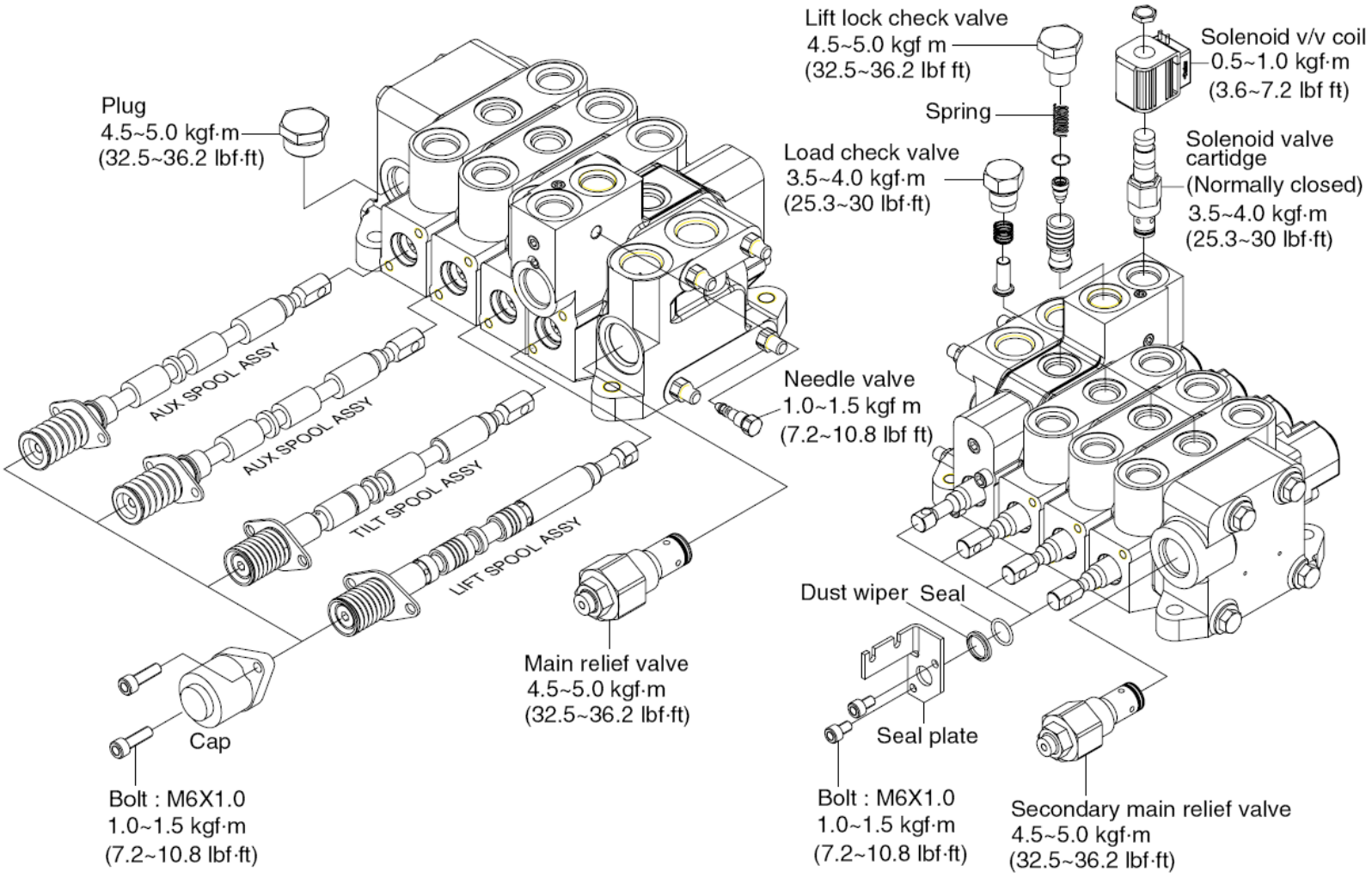
34

- 16/18/20B-7 Hydraulic Diagram (OPSS).



- Steering: 100Bar
- Main: 16B-7=160Bar
  18B-7=180Bar
  20B-7=190Bar
- Auxiliary: +/- 130Bar

- 15/18/20BT-7, 16/18/20B-7 MCV (OPSS).



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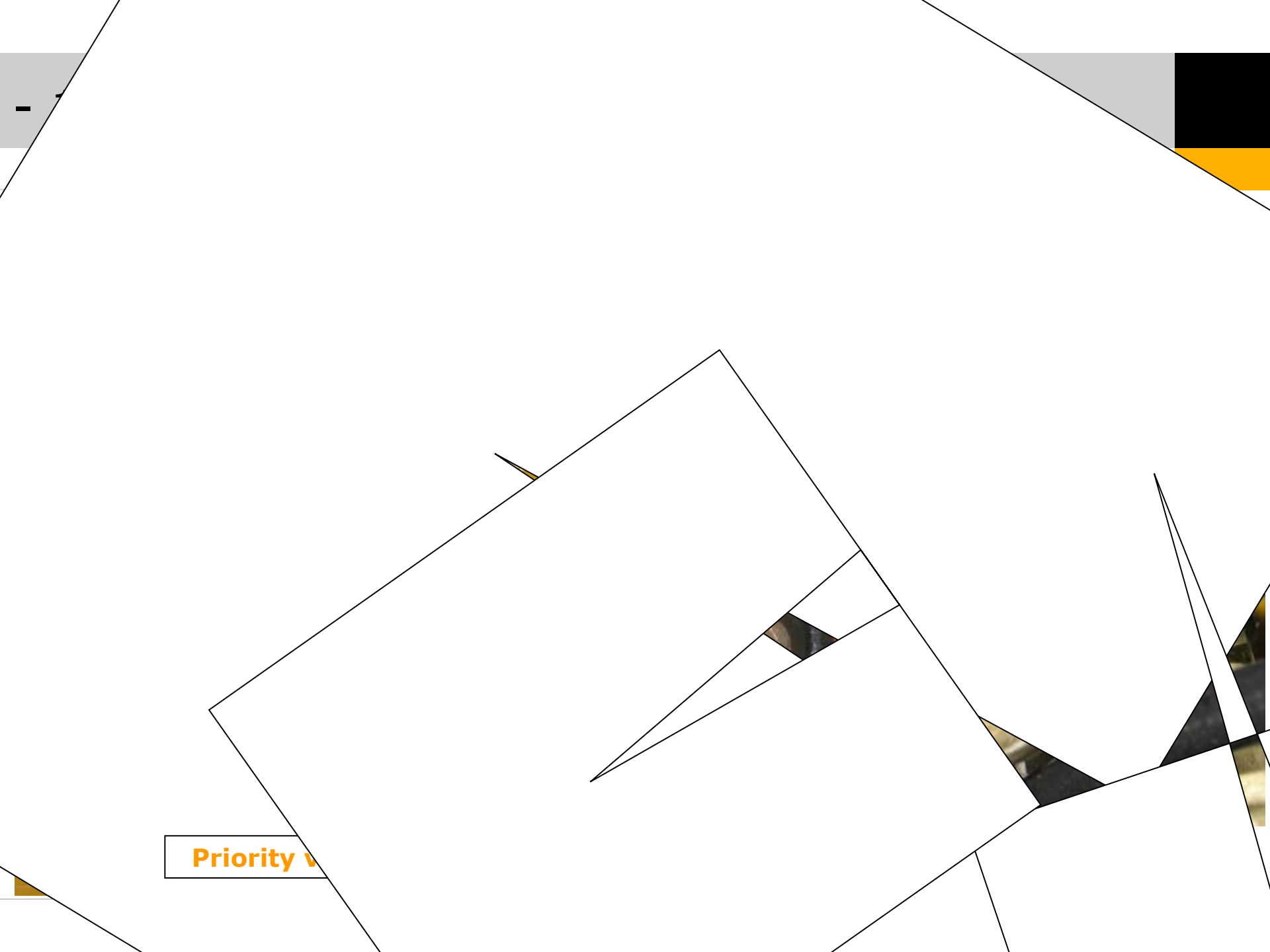
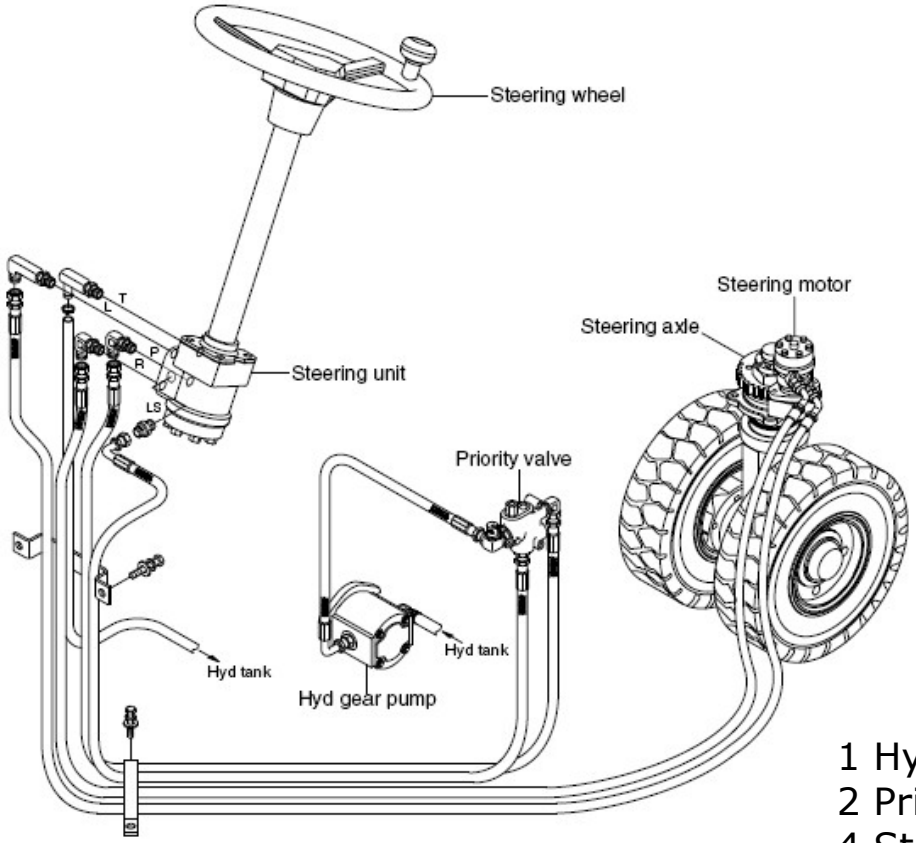
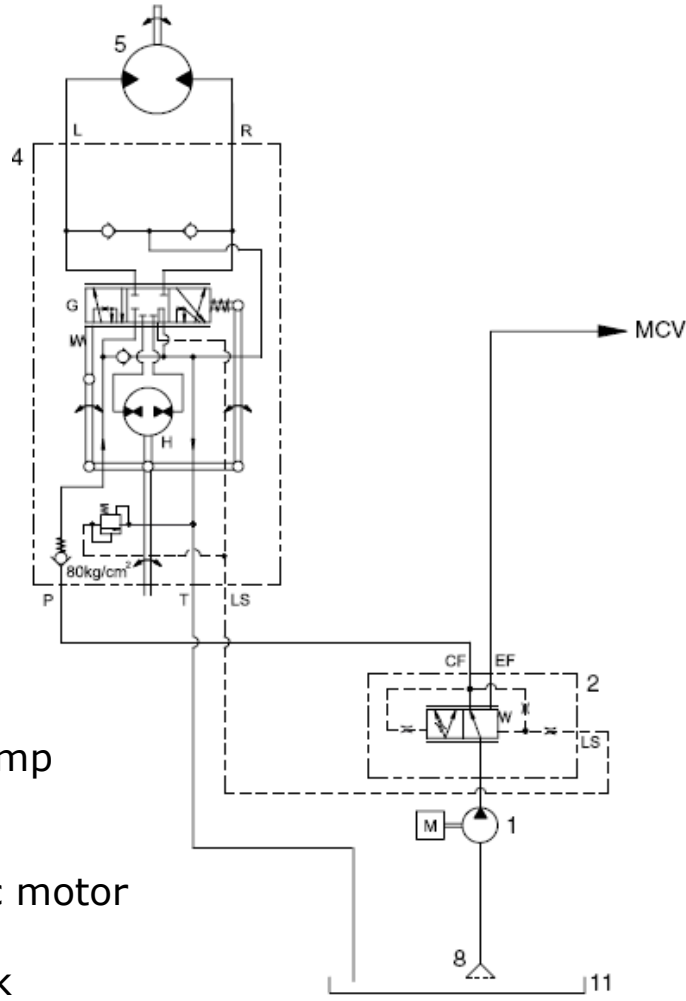

Priority v

- 15/18/20BT-7 Hydraulic Steering.

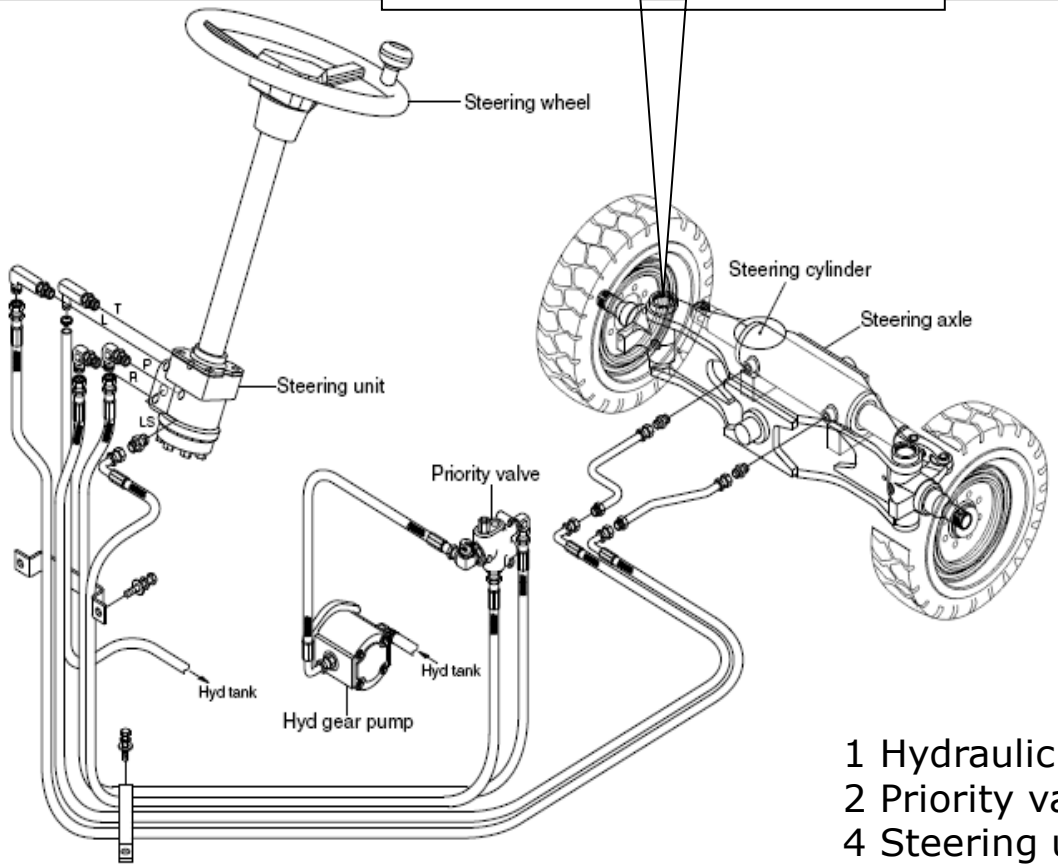


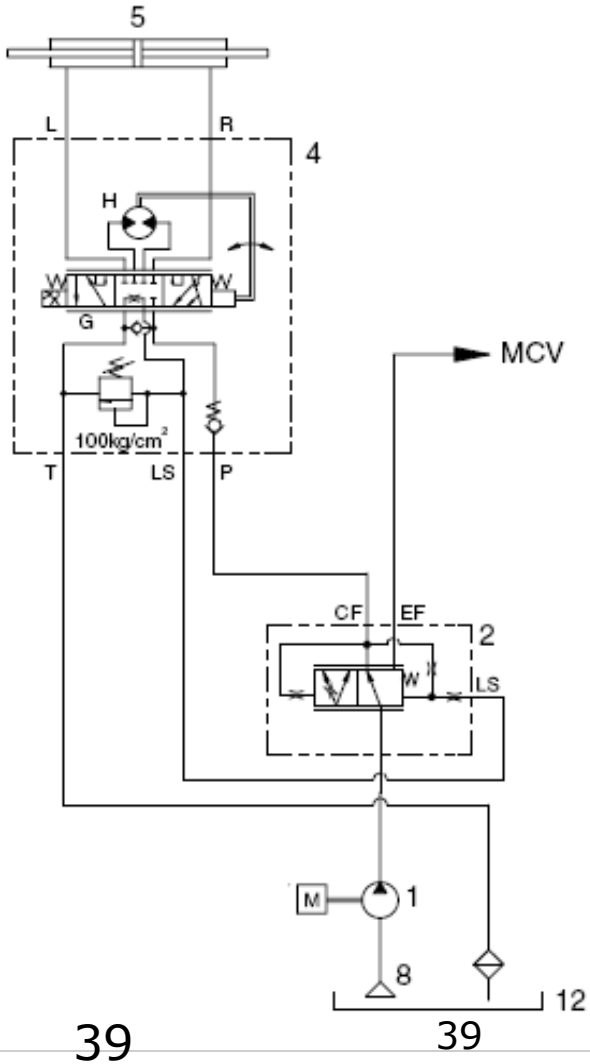


1 Hydraulic gear pump
2 Priority valve
4 Steering unit
5 Steering hydraulic motor
8 Suction strainer
11 Hydraulic oil tank

38

- 16/18/20 Hydraulic steering.





1 Hydraulic gear pump
2 Priority valve
4 Steering unit
5 Steering cylinder
8 Suction strainer
12 Hydraulic tank

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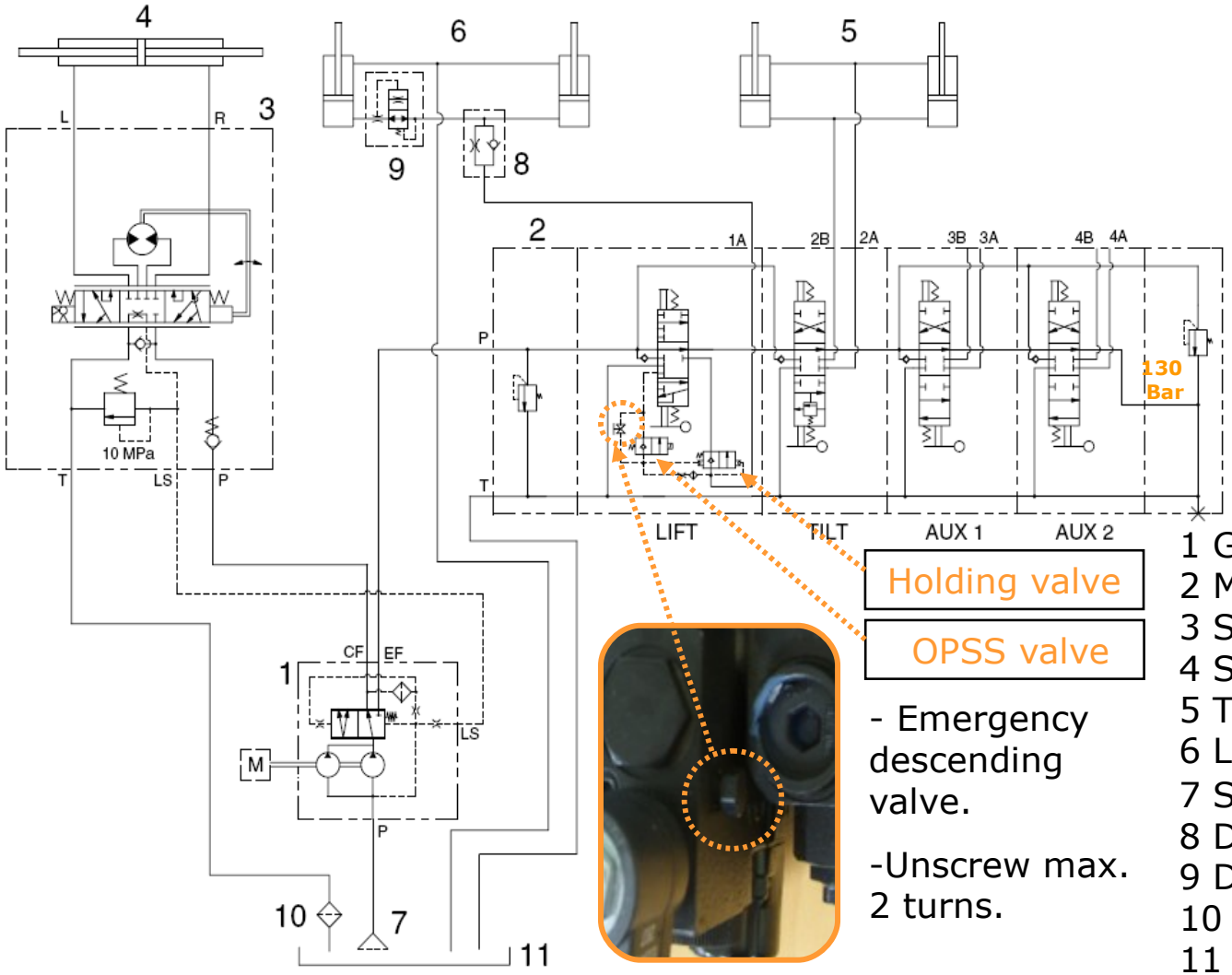
- 22/25/30/32B-7, 22/25/30BHA-7 Hydraulics

40

- 22/25/30/32B-7 Hydraulic Diagram.



Holding valve

OPSS valve

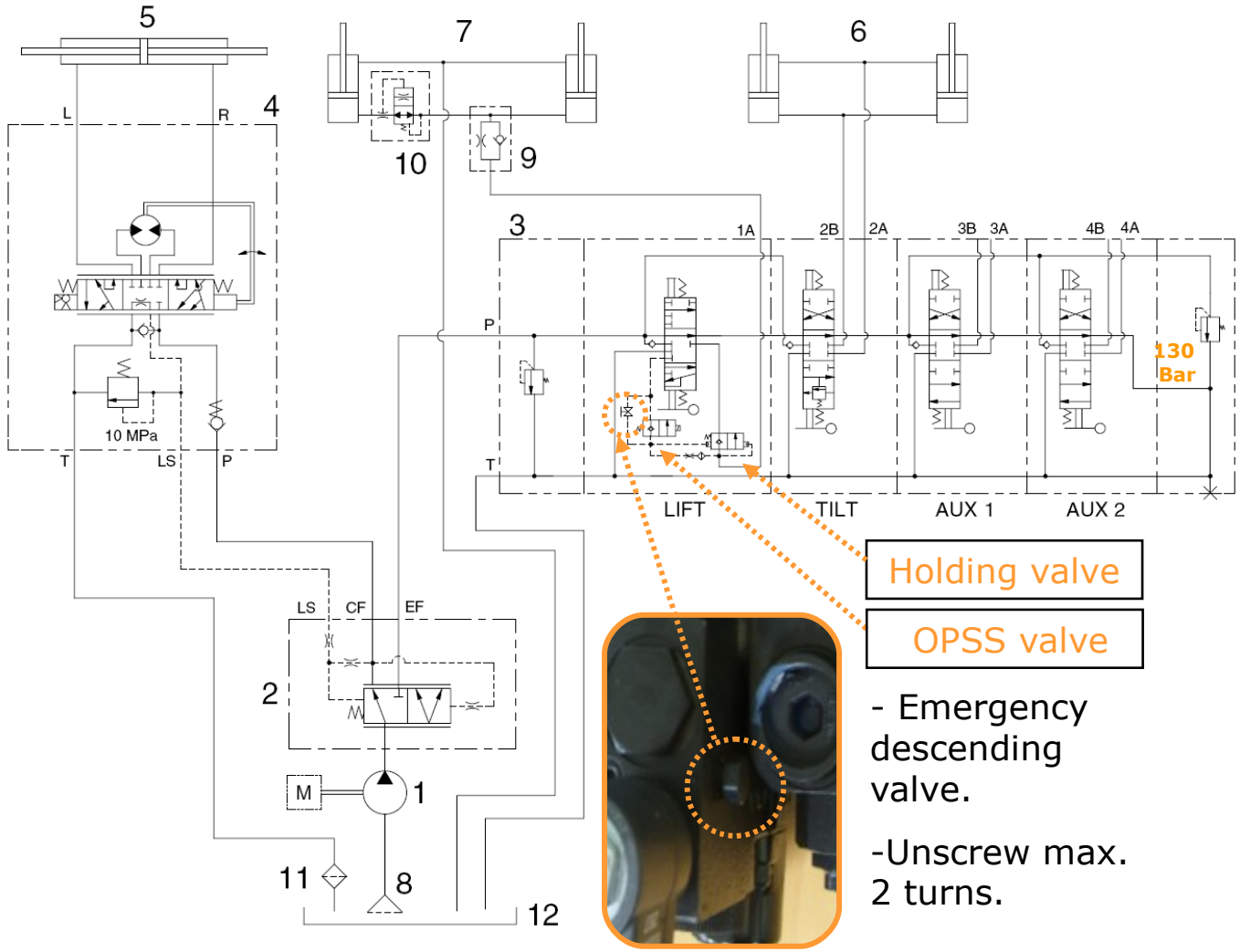
- Emergency descending valve.

-Unscrew max. 2 turns.

- Steering: 100Bar
- Main: 22B-7=160Bar
  25B-7=185Bar
  30B-7=180Bar
  32B-7=190Bar
- Auxiliary: +/- 130Bar

1 Gear pump + priority valve
2 Main control valve
3 Steering unit
4 Steering cylinder
5 Tilt cylinder
6 Lift cylinder
7 Suction strainer
8 Down control valve
9 Down safety valve
10 Return filter
11 Hydraulic oil tank

- 22/25/30BHA-7 Hydraulic Diagram.



Holding valve

OPSS valve

- Emergency descending valve.

-Unscrew max. 2 turns.

- Steering: 100Bar
- Main: 22BHA-7=160Bar
  25BHA-7=185Bar
  30BHA-7=180Bar
- Auxiliary: +/- 130Bar

1 Hydraulic gear pump
2 Priority valve
3 Main control valve
4 Steering unit
5 Steering cylinder
6 Tilt cylinder
7 Lift cylinder
8 Suction strainer
9 Down control valve
10 Down safety valve
11 Return filter
12 Hydraulic oil tank

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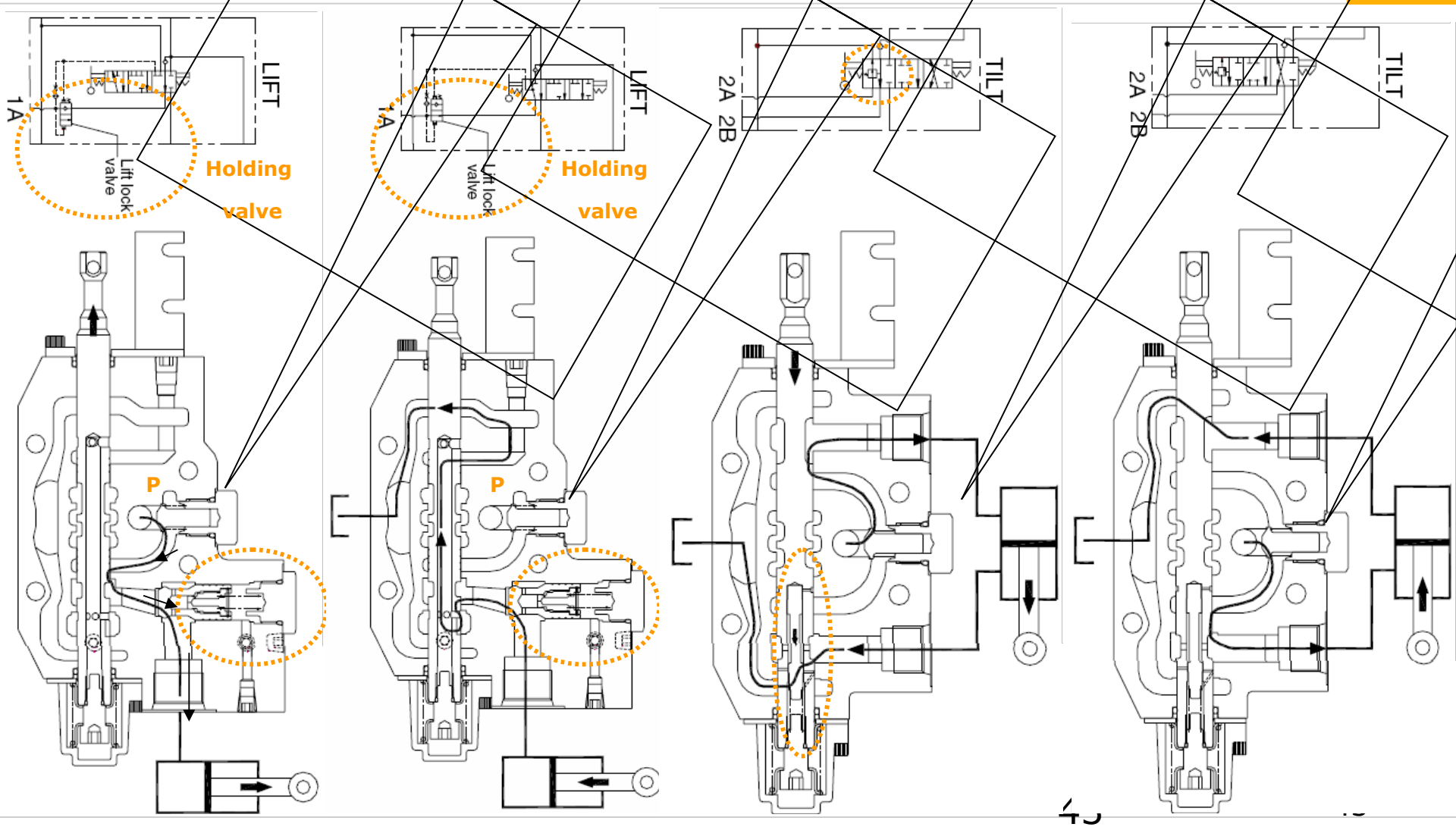
- 22/25/30/32B-7, 20/25/30BHA-7 MCV.



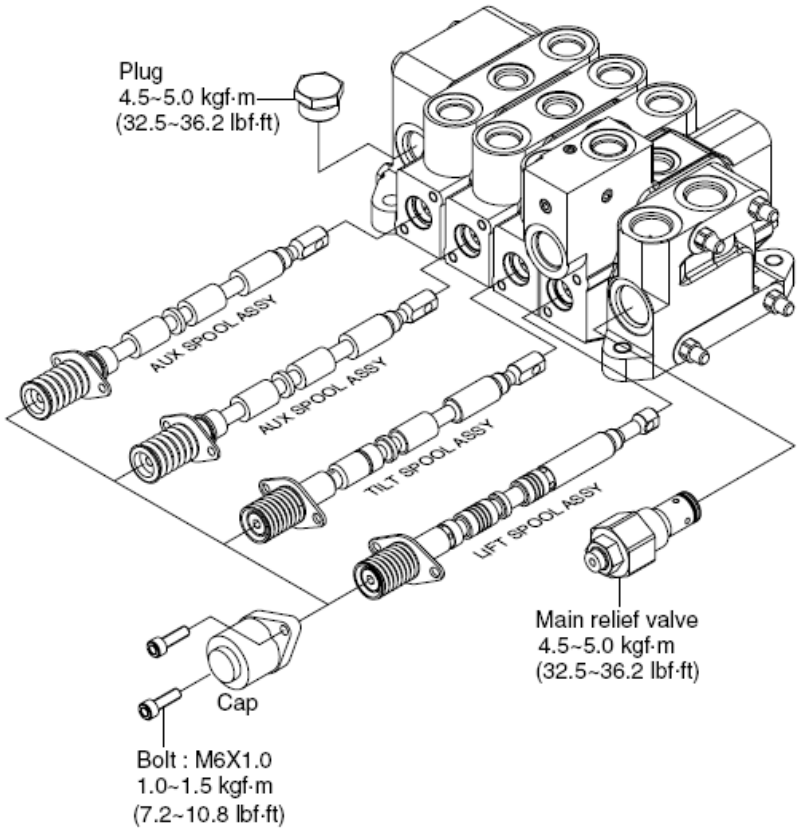
Lift position

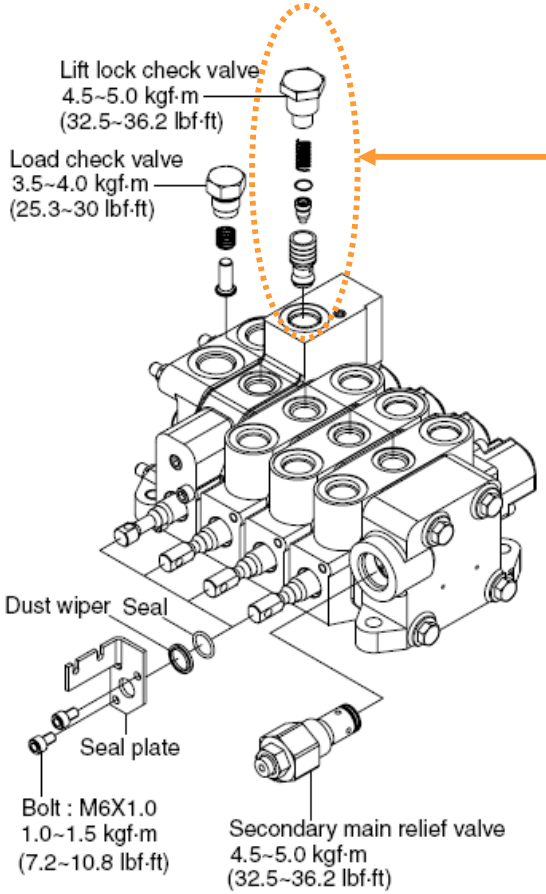
Lower position

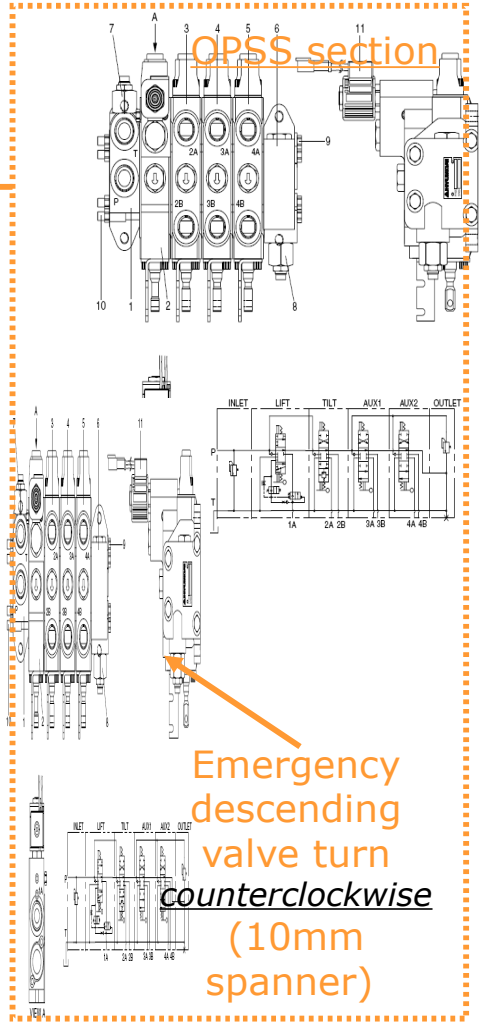
Tilt forward position

Tilt backwards position

- 22/25/30/32B-7, 20/25/30BHA-7 MCV.

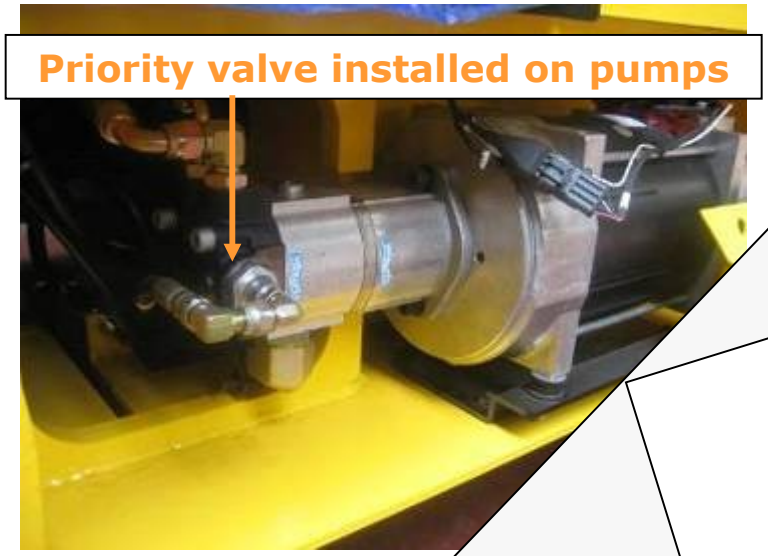


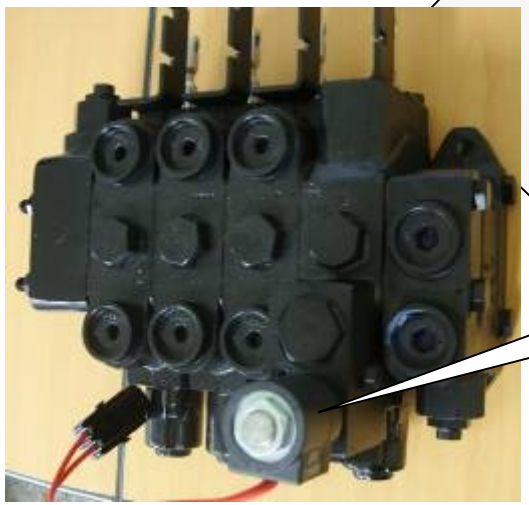




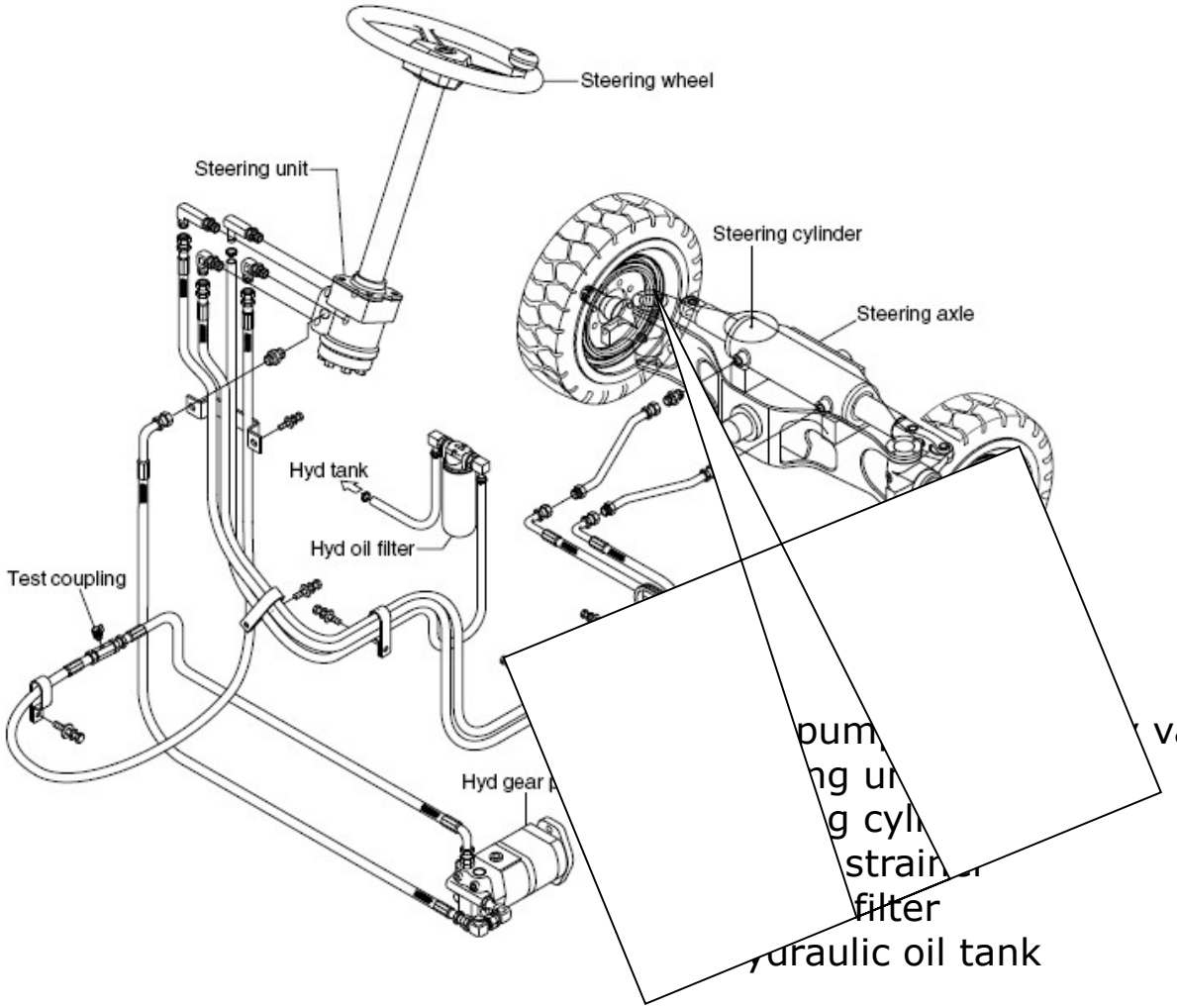
44

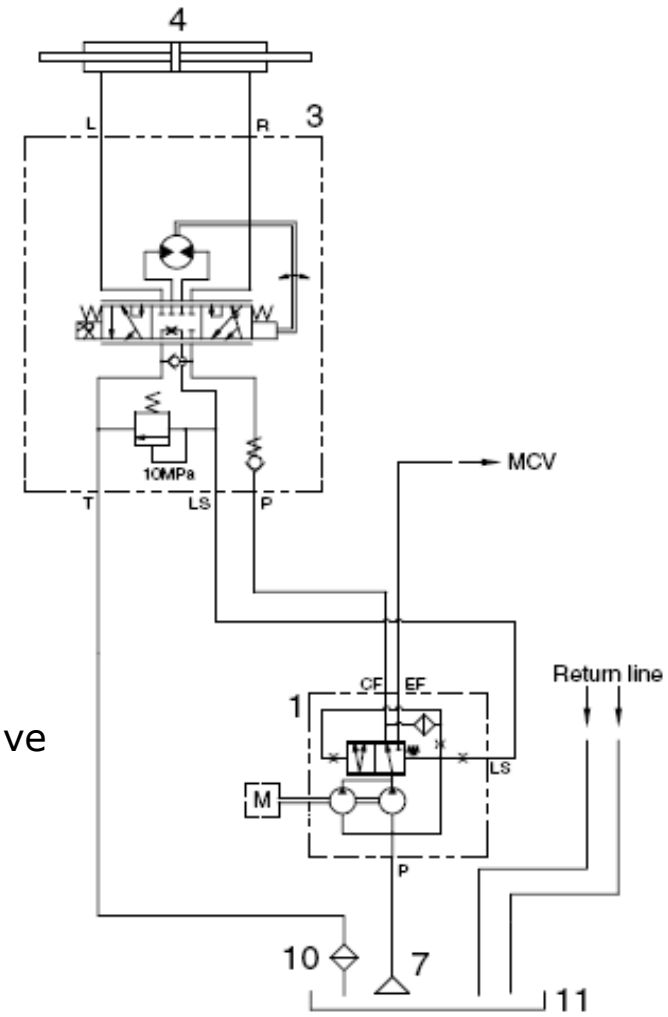
- 22/25/30/32B-7 Component location





- 22/25/30/32B-7 Hydraulic Steering.





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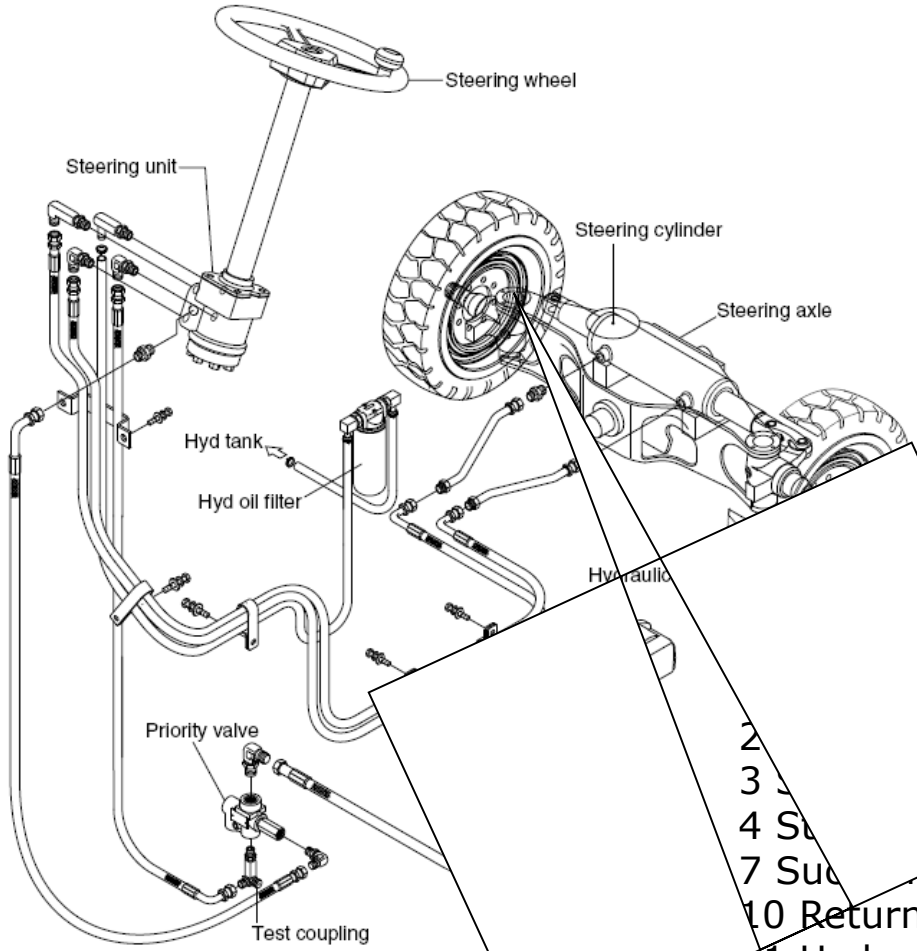
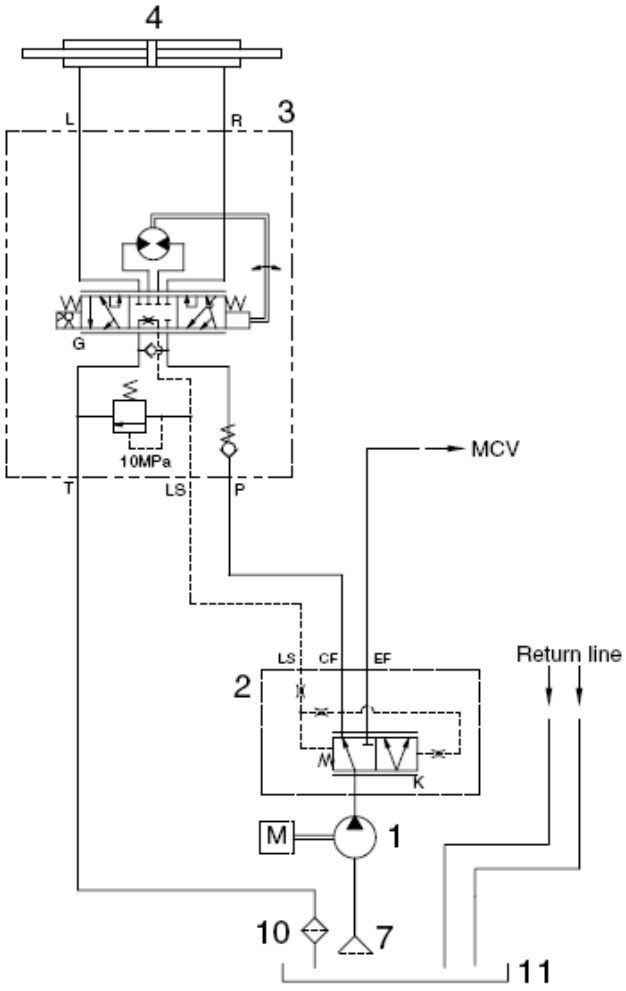
- 22/25/30BHA-7 Hydraulic Steering.





r pump

2

3

4 Su nder

7 Suc strainer

10 Return filter

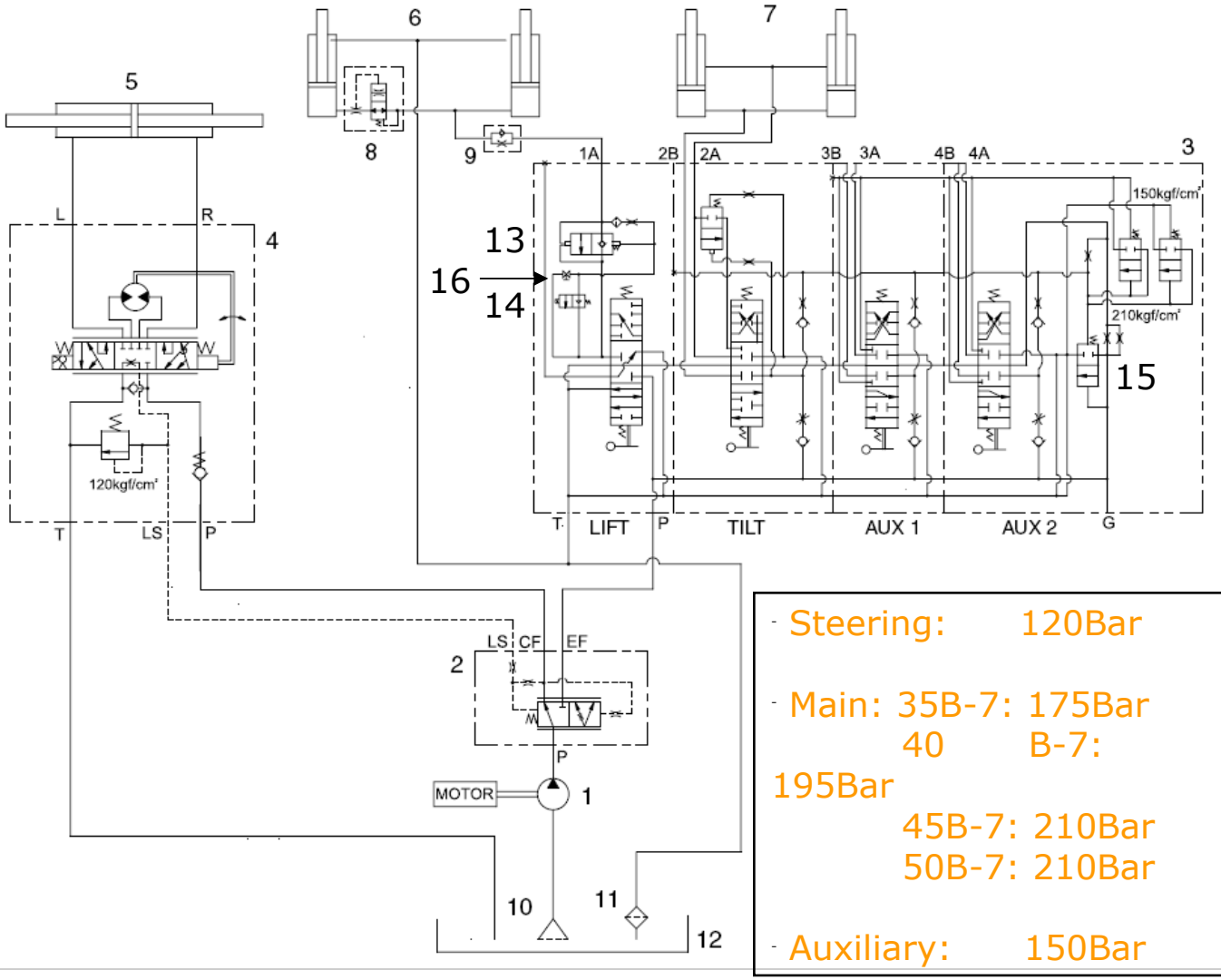
11 Hydraulic oil tank

47

- 35/40/45/50B-7 Hydraulics.

48

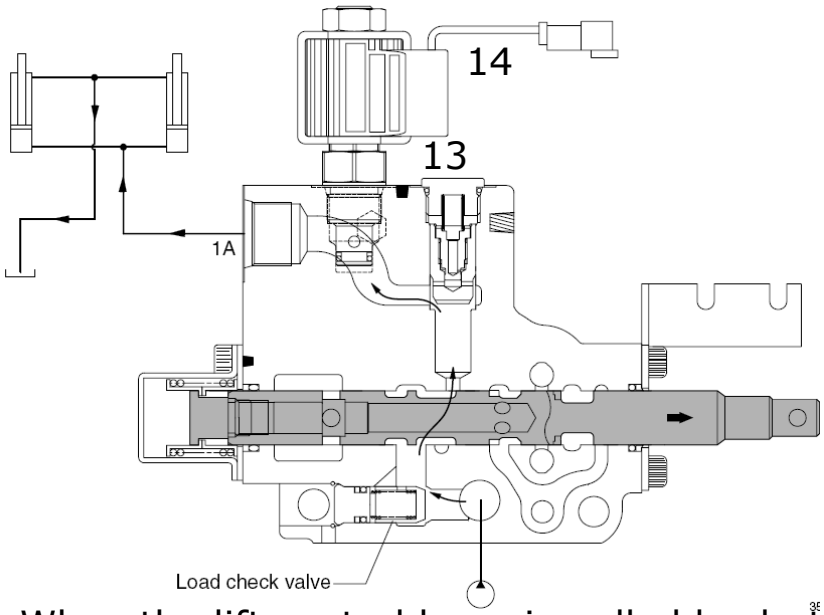
- 35/40/45/50B-7 Hydraulic Diagram.



- Steering: 120Bar
- Main: 35B-7: 175Bar
  40 B-7: 195Bar
  45B-7: 210Bar
  50B-7: 210Bar
- Auxiliary: 150Bar

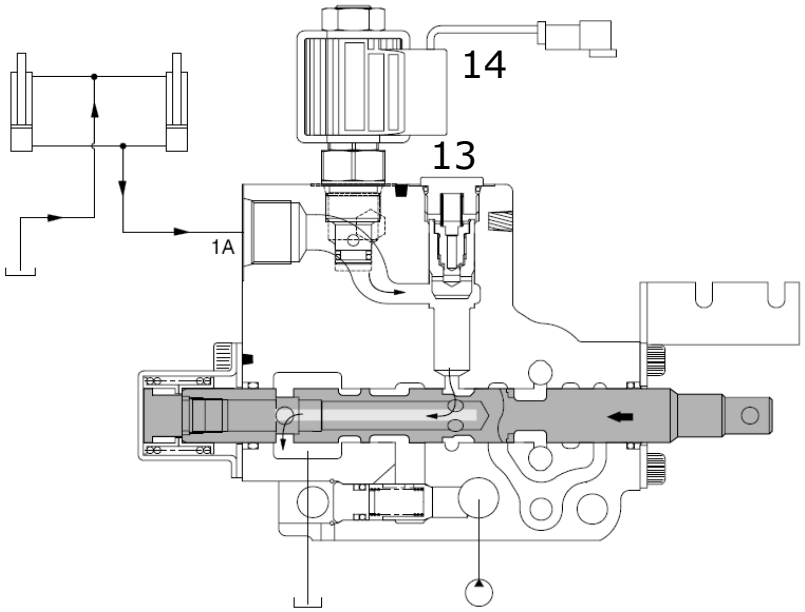
1 Hydraulic gear pump
2 Priority valve
3 Main control valve
4 Steering unit
5 Steering cylinder
6 Lift cylinder
7 Tilt cylinder
8 Down safety valve
9 Down flow regulator
10 Suction strainer
11 Return filter
12 Hydraulic oil tank
13 Holding valve
14 Lift lock valve (OPSS)
15 Hydrostat valve
16 Emergency descend

- 35/40/45/50B-7 Main Control Valve.



- When the lift control lever is pulled back, the spool moves to the right and the neutral passage is closed.
- Oil supplied from the pump pushes the load check valve up and flows into the lift cylinder port (1A).
- The pump pressure reaches proportionally the cylinder. Fine control is possible by closing the neutral passage.
- The return oil from cylinder flows into the tank.

Lift

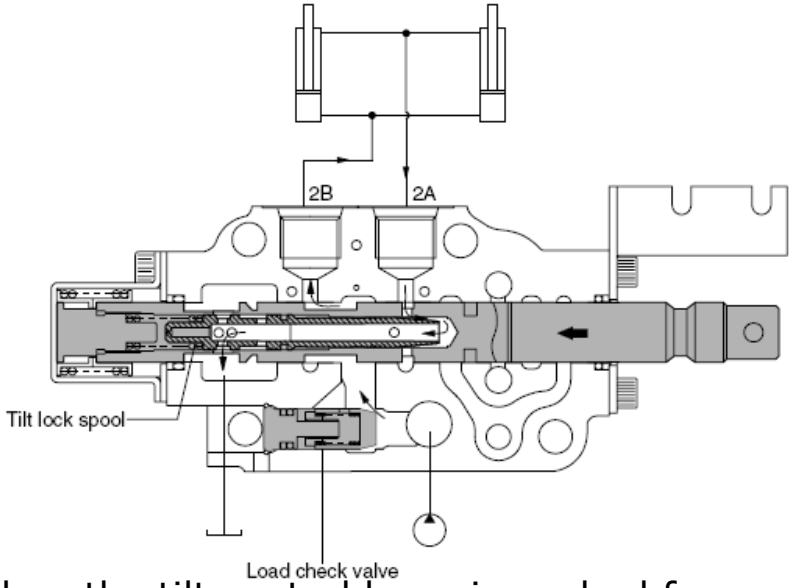


- When the lift control lever is pushed forward, the spool moves to the left and the neutral passage is closed.
- The spool moves to the lift lower position, opening up the neutral passage to tank and (1A) > T.
- In lift lower position the fork drops due to its own weight.

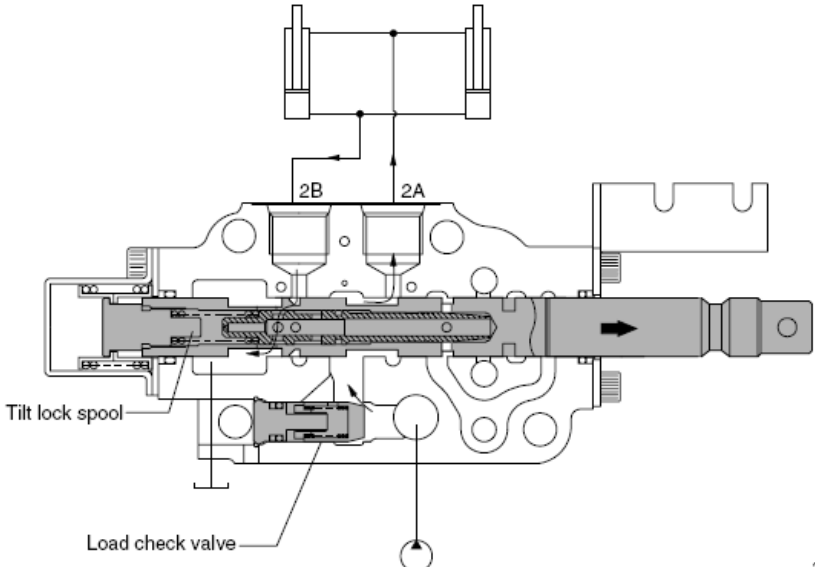
Lowering position

50

- 35/40/45/50B-7 Main Control Valve.



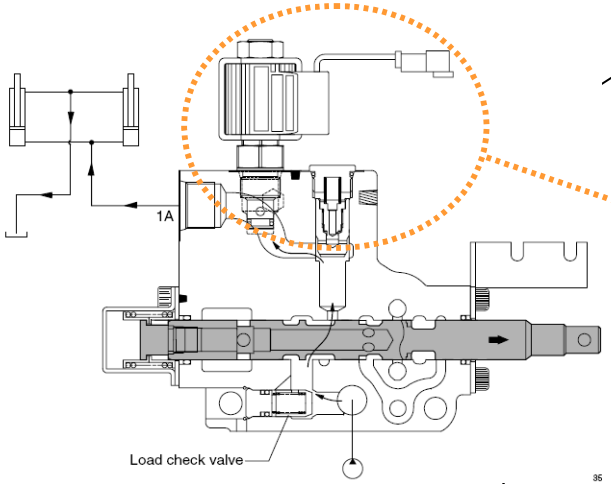
- When the tilt control lever is pushed forward, the spool moves to the left and closes the neutral passage.
- Oil supplied from the pump pushes the load check valve and oil flows into the tilt cylinder port(2B).
- The pump pressure reaches proportionally the cylinder. Fine control is possible by closing the neutral passage.
- Return oil coming from the cylinder port(2A) flows into the tank through a hole inside the tilt lock spool.



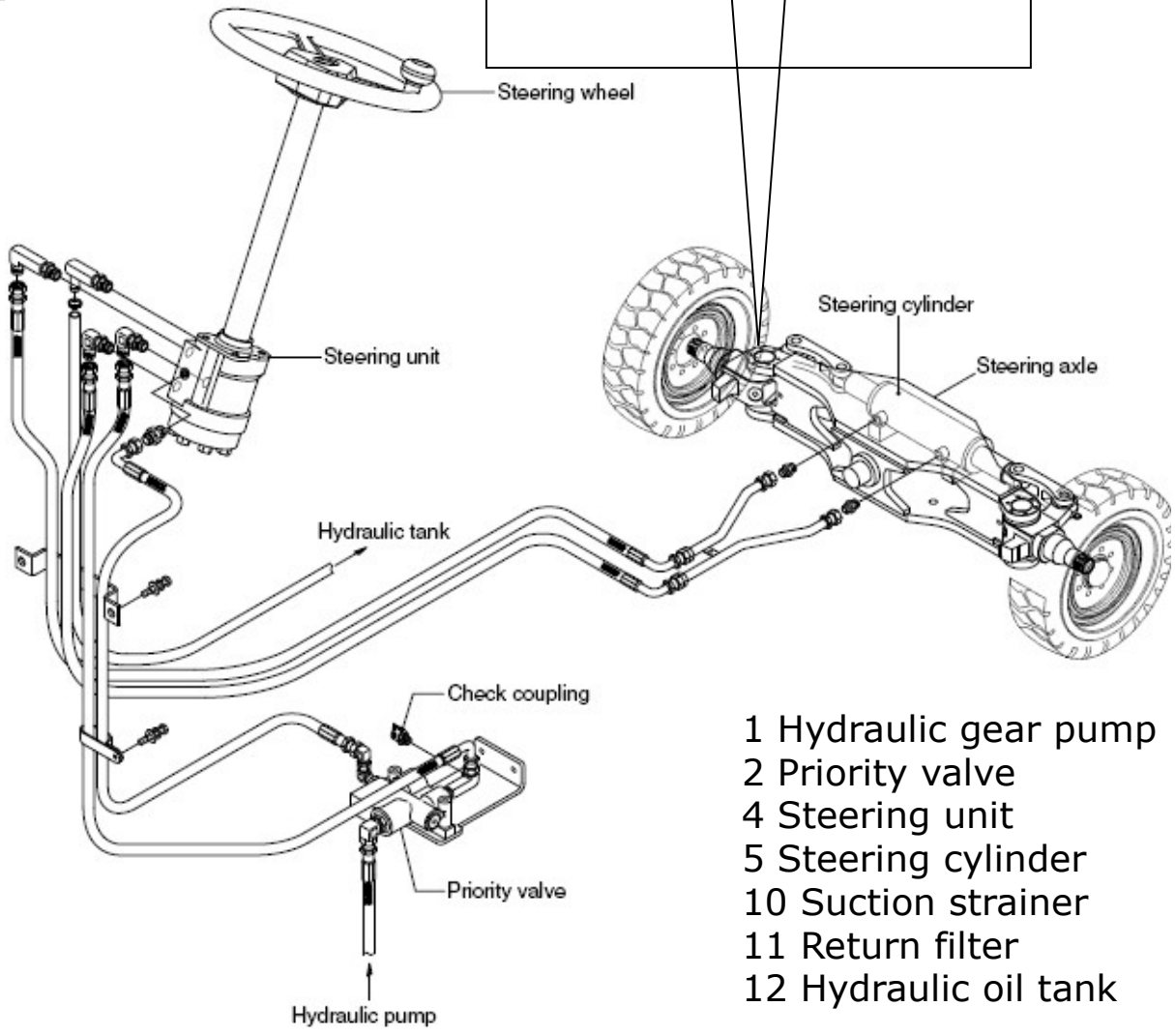
- When the tilt control lever is pulled back, the spool moves to the right and closes the neutral passage.
- Oil supplied from the pump pushes the load check valve and oil flows into tilt cylinder port(2A).
- The pump pressure reaches proportionally the cylinder. Fine control is possible by closing the neutral passage.
- Return oil from cylinder port(2B) flows into the tank via the low pressure passage.

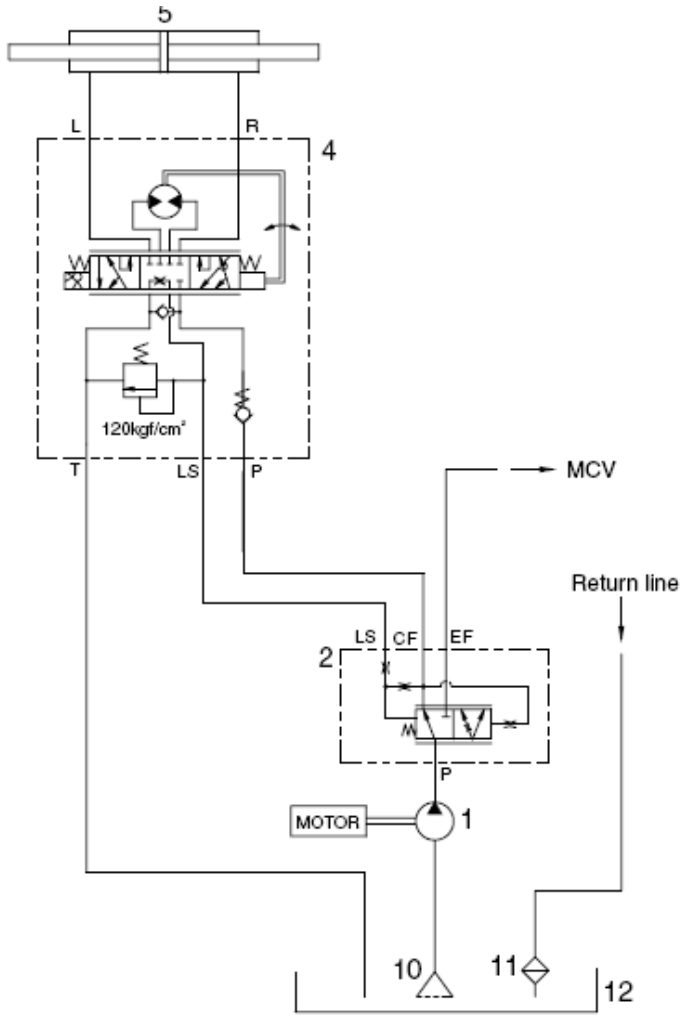
- 35/40/45/50B-7 MCV and Priority valve.

OPSS section



- 35/40/45/5 lyc Steering.





1 Hydraulic gear pump
2 Priority valve
4 Steering unit
5 Steering cylinder
10 Suction strainer
11 Return filter
12 Hydraulic oil tank

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Electric systems

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- 15/18/20BT-7, 16/18/20B-7 Electric System.

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-15/18/20BT-7, 16/18/20B-7 Component location

1 Combination switch

2 Display

3 Working lamp switch (opt)

4 Beacon switch (opt)

5 DC-DC converter

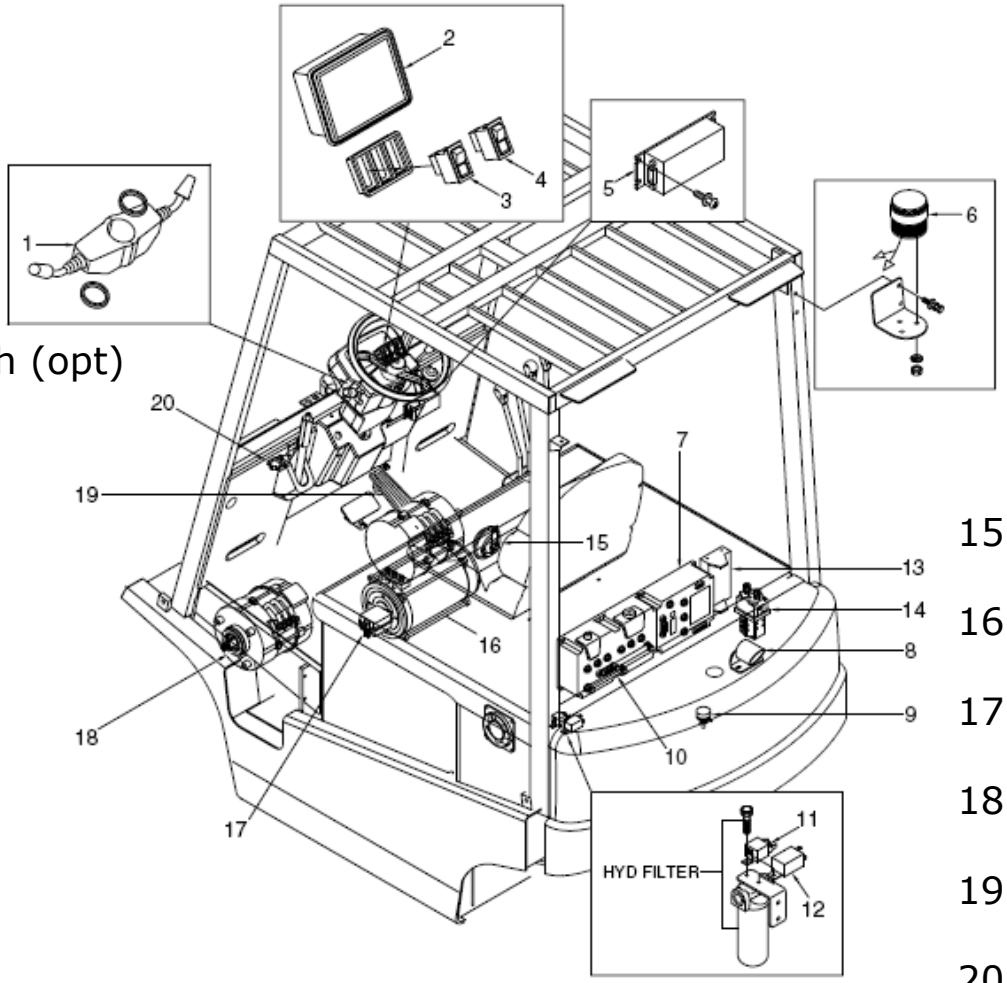
6 Beacon lamp (opt)

7 Pump controller

8 Back up alarm

9 Steering sensor

10 Traction controller



11 Relay

12 Flasher unit assy.

13 Fan assy.

14 Contactor

15 High horn

16 Pump motor

17 Fuse box assy.

18 Drive motor

19 Accelerator assy.

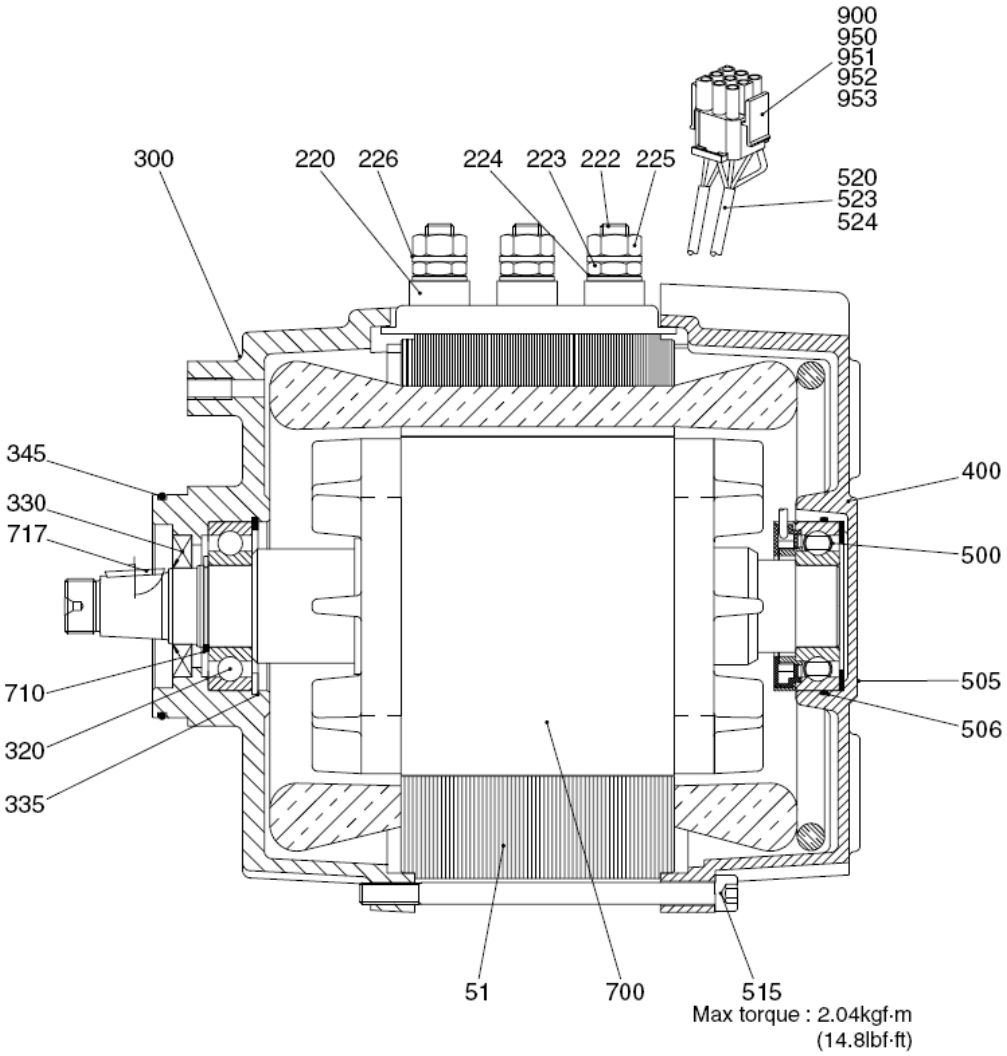
20 Parking micro switch

56

- 15/18/20BT-7, 16/18/20B-7 Traction Motor.

Sauer Danfoss drive motor . (4,4Kw).

51 Stator
220 Terminal
222 Hexagon screw
223 Hexagon nut
224 Disk
225 Hexagon nut
226 Disk
300 Drive end cover
320 Ball bearing
330 Sealing ring
335 Circlip
345 O-ring
400 Plate
500 Sensor bearing

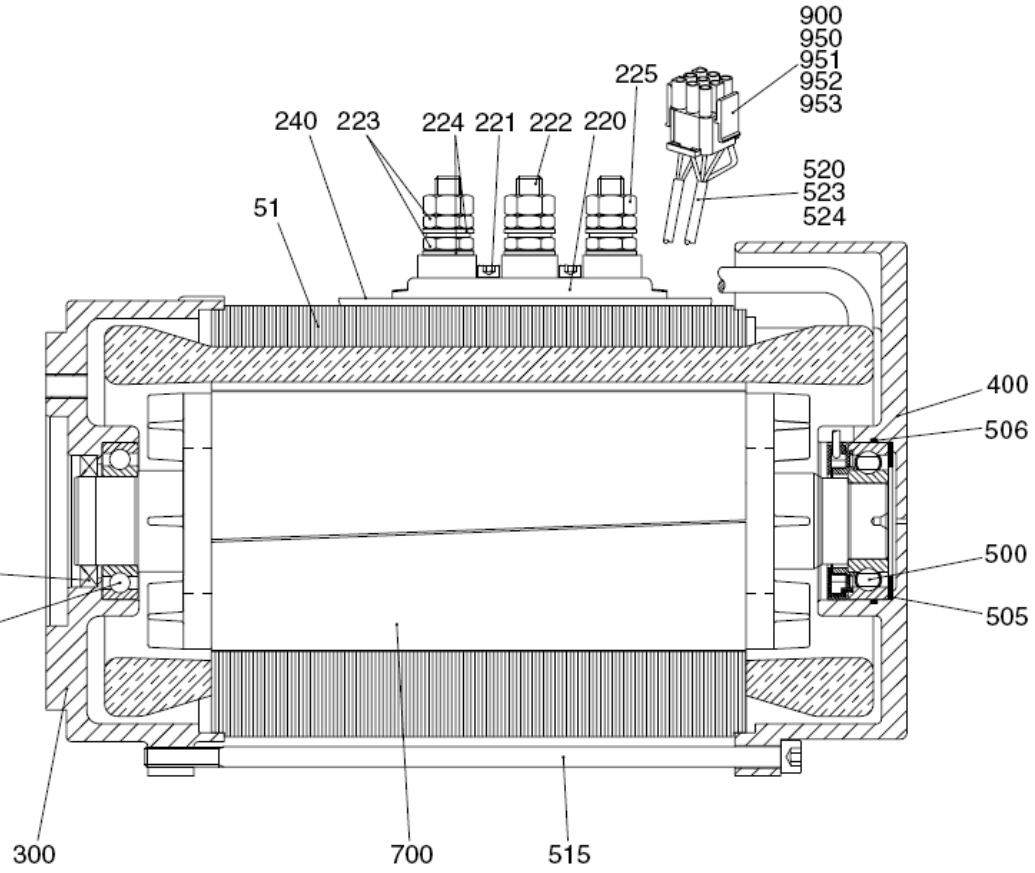


505 Wavy washer
506 O-ring
515 Cylinder screw
520 Temp sensor
523 Tube
524 Amp pin
700 Rotor
710 Circlip
717 Woodruff key
900 Plug
950 Amp pin
951 Amp plug
952 Wire seal
953 Amp seal

- 15/18/20BT-7, 16/18/20B-7 Pump Motor.

Sauer Danfoss pump motor. (15,8Kw)

51 Stator
220 Terminal
221 Cylinder screw
222 Hexagon screw
223 Hexagon nut
224 Disk
225 Hexagon nut
240 Terminal base
300 Drive end cover
320 Ball bearing
327 Shaft seal
400 End plate
500 Sensor bearing



505 Wavy washer
506 O-ring
515 Cylinder bolt
520 Temp sensor
523 Tube
524 Amp pin
700 Rotor
900 Plug
950 Amp pin
951 Keying plug
952 Wire seal
953 Interface seal

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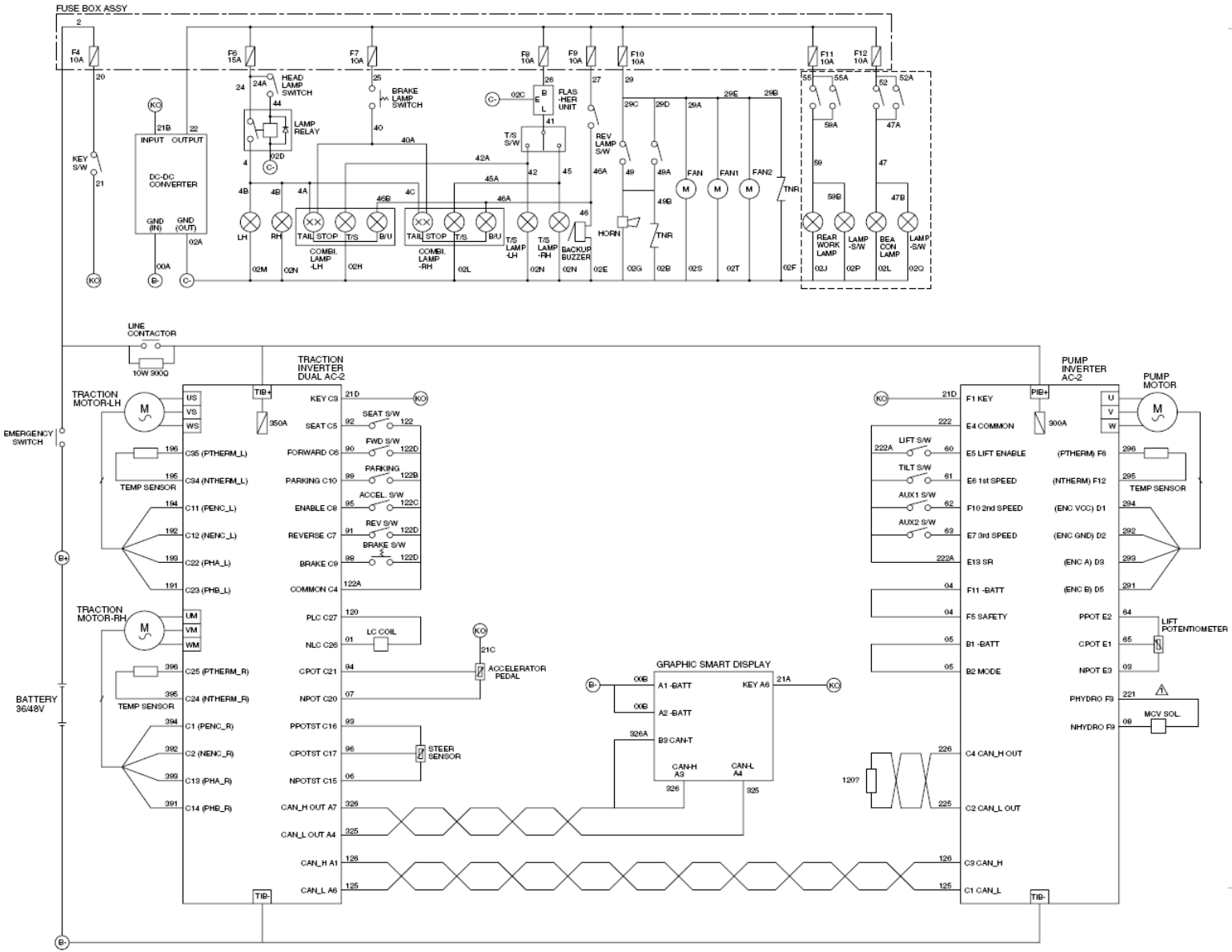
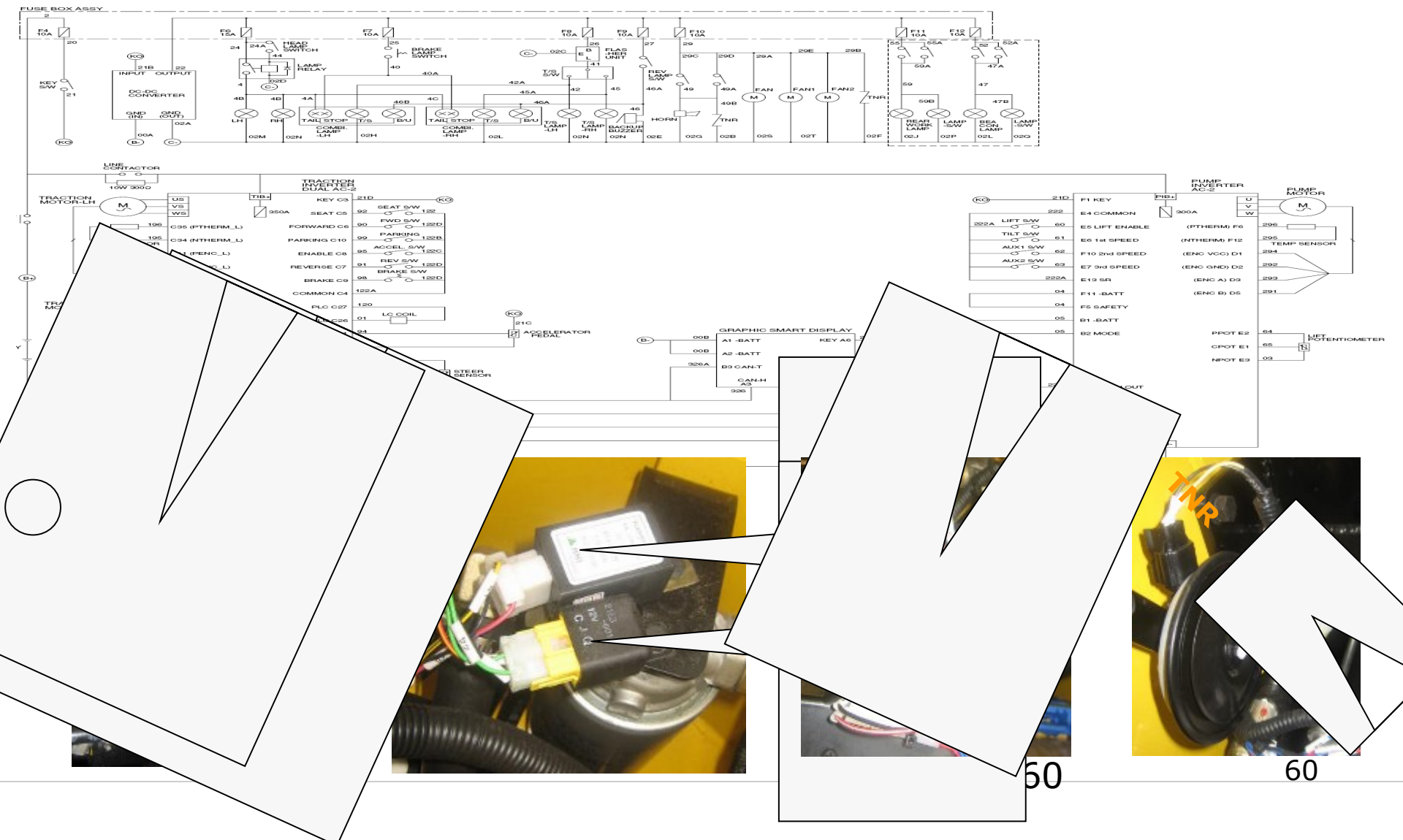
- 15/18/20BT-7, 16/18/20B-7 Electric Diagram.

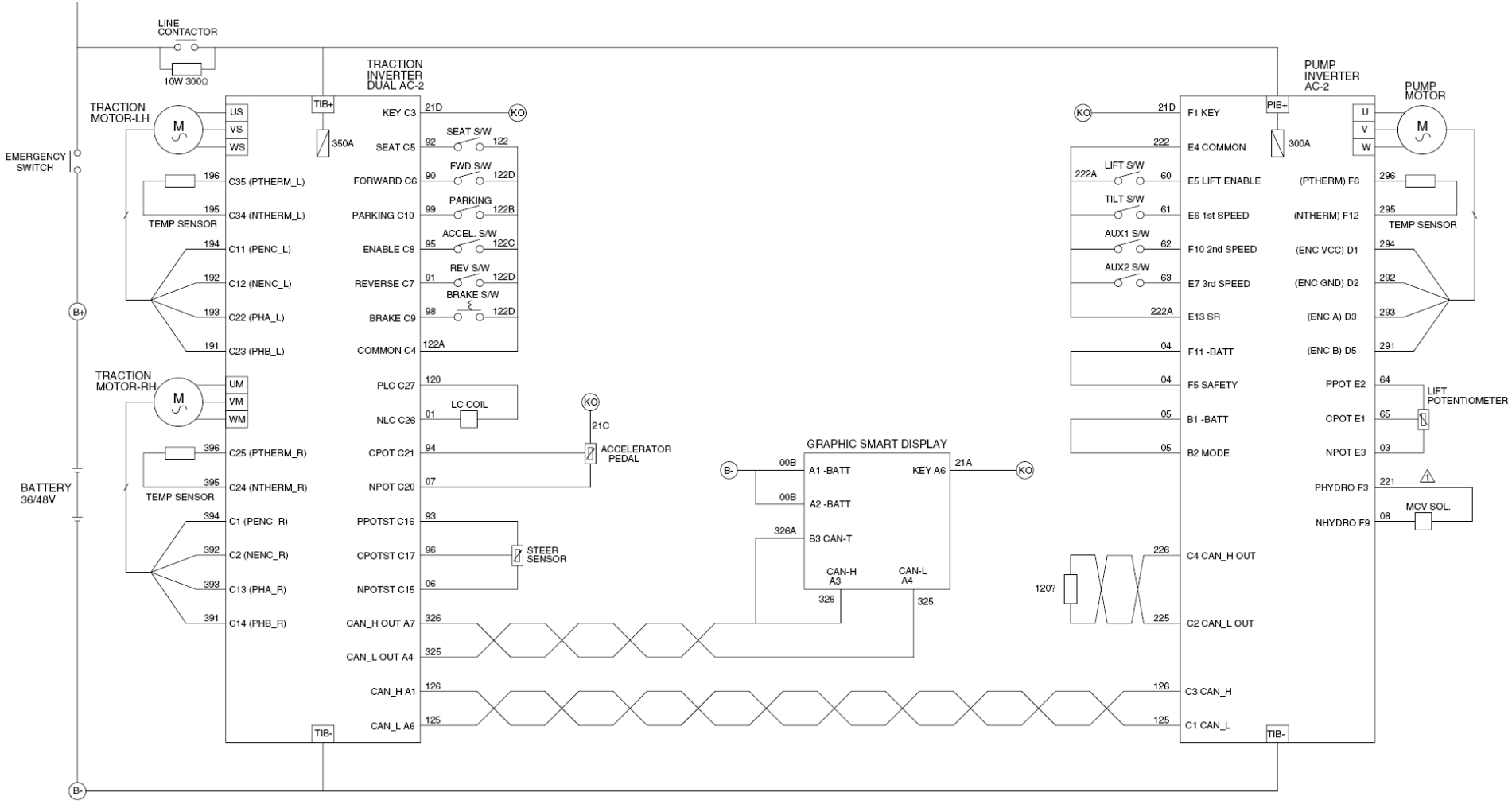


- 15/18/20BT-7, 16/18/20B-7 DC System. (Behind converter)



60

- 15/18/20BT, 16/18/20B-7 AC System.



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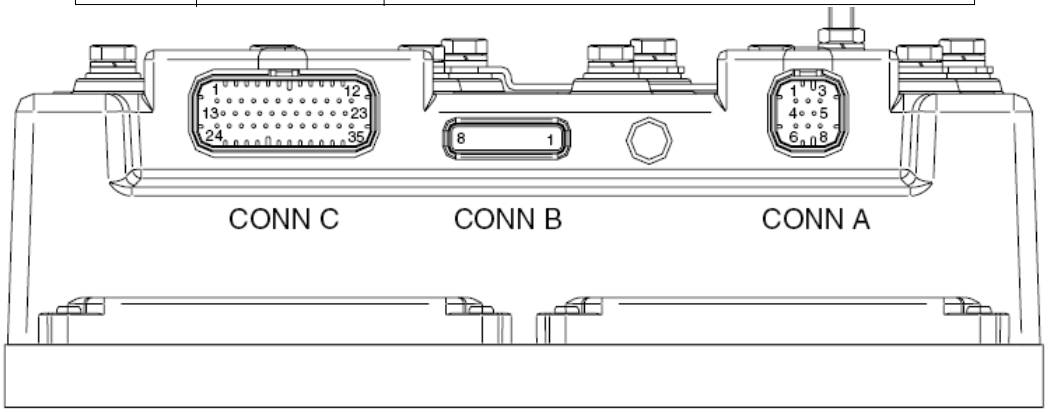
- 15/18/20BT-7, 16/18/20B-7 Traction Config.

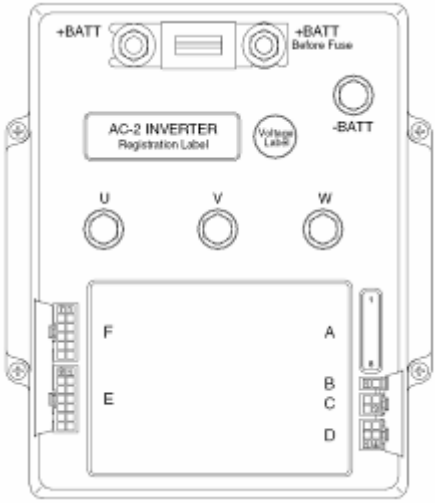
No. of Pin	Function	Description
A1	CAN_H	High level CANBUS.
A2	CANT_H	CANBUS termination output, 120 ohm internally connected to CAN_H. Connect to CAN_L_OUT to insert the termination.
A3	CAN_POS	Positive of CAN circuit; to be used in case of optoisolated CANBUS.
A4	CAN_L_OUT	Low level CANBUS: to be used as repetition for CAN_L line or to be connected to CANT_H to insert termination resistance.
A5	CANT_L	CANBUS termination output, 120 ohm internally connected to CAN_L. Connect to CAN_H_OUT to insert the termination.
A6	CAN_L	Low level CANBUS.
A7	CAN_H_OUT	High level CANBUS: to be used as repetition for CAN_ H line or to be connected to CANT_L to insert termination resistance.
A8	CAN_NEG	Negative of CAN circuit, to be used in case of optoisolated CANBUS.
B1	PCLRXD	Positive serial reception.
B2	NCLRXD	Negative serial reception.
B3	PCLTXD	Positive serial transmission.
B4	NCLTXD	Negative serial transmission.
B5	GND	Negative console power supply.
B6	+12	Positive console power supply.
B7	FLASH	
B8	FLASH	
C1	PENC_R	Positive of right motor encoder power supply (+5 V/+12 V).
C2	NENC_R	Negative of right motor encoder power supply.
C3	KEY	Connected to + batt trough a microswitch and a 10 A fuse in series.
C4	CM	Common of FW / REV / HB / PB / SEAT / ENABLE / SR / EX. HYDRO / BACKING microswitches.
C5	SEAT	Seat presence signal; active high.
C6	FORWARD	Forward direction request signal; active high.
C7	REVERSE	Reverse direction request signal; active high.
C8	ENABLE/BACK.	Traction or backing request signal; active high.
C9	PB	Pedal brake request signal; active high.
C10	SR/HB/EX. HYDRO	Speed reduction signal or hand brake or exclusive hydro input; active low (microswitch open). See also page 7-24.
C11	PENC_L	Positive of left motor encoder power supply (+5 V/+12 V).
C12	NENC_L	Negative of left motor encoder power supply.
C13	PHA_R	Right motor encoder phase A.
C14	PHB_R	Right motor encoder phase B.
C15	NPOTST	Negative of steering potentiometer (-BATT).
C16	PPOTST	Positive of steering potentiometer (+5 V/+12 V).
C17	CPOTST	Steering potentiometer wiper signal.
C18	CPOTB	Brake potentiometer wiper signal.

Model	Model	Application	Type	Power	Current limit
15/18/20BT-7 16/18/20B-7	DUAL AC2	Traction	AC	36-48V, 330A+330A	330A / 3min
	AC2	Pump	AC	36-48V, 450A	450A / 3min

No. of Pin	Function	Description
C19	NPOTB	-BATT.
C20	NPOT	Negative of traction accelerator potentiometer, tested for wire is connection diagnosis.
C21	CPOT	Traction potentiometer wiper signal.
C22	PHA_L	Left motor encoder phase A.
C23	PHB_L	Left motor encoder phase B.
C24	NTHERM_R	Negative of right traction motor temperature sensor.
C25	PTHERM_R	Right traction motor temperature signal.
C26	NLC	Output of main contactor coil driver (drives to -BATT).
C27	PLC	Positive of main contactor coil.
C28	NBRAKE	Output of electric brake coil; drives the load to -BATT, maximum current 3 A.
C29	PBRAKE	Positive of the electromechanical brake coil.
C30	PAUX	Positive of auxiliary load.
C31	NAUX	Output of auxiliary load driver (drives to -BATT).
C32	-BATT	
C33	PPOT	Traction/brake potentiometer positive, 5/10 V output; use load > 1 kohm.
C34	NTHERM_L	Negative of left traction motor temperature sensor.
C35	PTHERM_L	Left traction motor temperature signal.



-15/18/20BT-7, 16/18/20B-7 Pump Configuration



No. of pin	Function	Description
A1	PCLRXD	Positive serial reception.
A2	NCLRXD	Negative serial reception.
A3	PCLTXD	Positive serial transmission.
A4	NCLTXD	Negative serial transmission.
A5	GND	Negative console power supply.
A6	+12	Positive console power supply.
A7	FLASH	Must be connected to A8 for the flash memory programming (if used).
A8	FLASH	Must be connected to A7 for the flash memory programming (if used).
B1	-BATT	-Batt.
B2	MODE	This input allows the customer to select the software in case of double version.
C1	CAN-L	Low level CAN-BUS voltage I/O.
C2	CAN-L-OUT	Low level CAN-BUS voltage I/O.
C3	CAN-H	High level CAN-BUS voltage I/O.
C4	CAN-H-OUT	High level CAN-BUS voltage I/O.

No. of pin	Function	Description
D1÷D6		Incremental ENCODER connector.
E1	CPOT	Accelerator potentiometer wiper.
E2	PPOT	Potentiometer positive: 10V output; keep load > 1KW.
E3	NPOT	Negative of accelerator unit, tested for wire disconnection diagnosis.
E4	CM	Common of LIFT ENABLE / 1st SPEED / 2nd SPEED / 3rd SPEED / 4th SPEED / HYDRO / SR microswitches.
E5	LIFT ENABLE	Input for potentiometer lifting enable input; it is active HIGH.
E6	1st SPEED	Input for first speed request; it is active HIGH.
E7	3rd SPEED	Input for third speed request; it is active HIGH.
E8	AN. IN.	Rotary encoder analog input.
E9	PPOT	Potentiometer positive: 10V output; keep load > 1KW.
E10	-BATT	-Batt.
E11	-BATT	-Batt.
E12	HYDRO REQ.	Input for hydraulic steering request. Active high.
E13	SR	Speed reduction input. Active low (switch opened).
E14	DIG. IN.	This is a digital input, free for customer request.
F1	KEY	Connected to the power supply through a microswitch (CH) with a 10A fuse in series.
F2	PMC	Positive of the auxiliary output.
F3	PHYDRO	Positive for the hydraulic steering contactor.
F4	4th SPEED	Input for fourth speed request; it is active HIGH.
F5	SAFETY	If not connected to -batt the MC coil power output will be disabled. Can also be used as a general purpose input.
F6	PTHERM	Input for motor temperature sensor.
F7	CM	Common of LIFT ENABLE / 1st SPEED / 2nd SPEED / 3rd SPEED / 4th SPEED / HYDRO / SR microswitches.
F8	NMC	This output can be used for drive the main contactor coil (single pump configuration) or to drive an auxiliary load (combi configuration)
F9	NHYDRO	Auxiliary output; drives the load to -batt. maximum current: 3A.
F10	2nd SPEED	Input for second speed request; it is active HIGH.
F11	GND	-Batt.
F12	NTHERM	-Batt.

- 22/25/30/32B-7, 22/25/30BHA-7 Electric system.

- 22/25/30/32B-7 Electric Component location.

1 Combination switch

2 Accelerator assy.

3 Parking micro switch

4 High horn

5 Drive motor

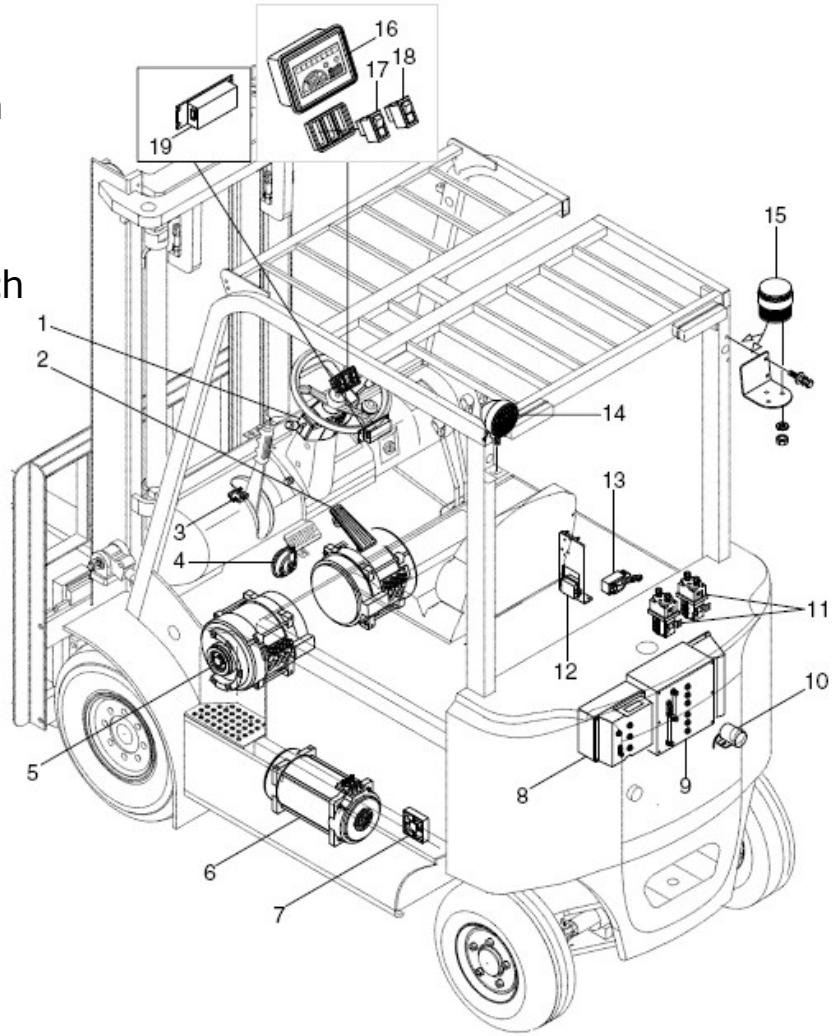
6 Pump motor

7 Fan assy.

8 Pump controller

9 Traction controller

10 Back up alarm



11 Contactor

12 Fuse box assy.

13 SBR switch assy.

14 Working lamp (opt)

15 Beacon lamp (opt)

16 Display

17 Work lamp switch (opt)

18 Beacon lamp switch (opt)

19 DC-DC converter

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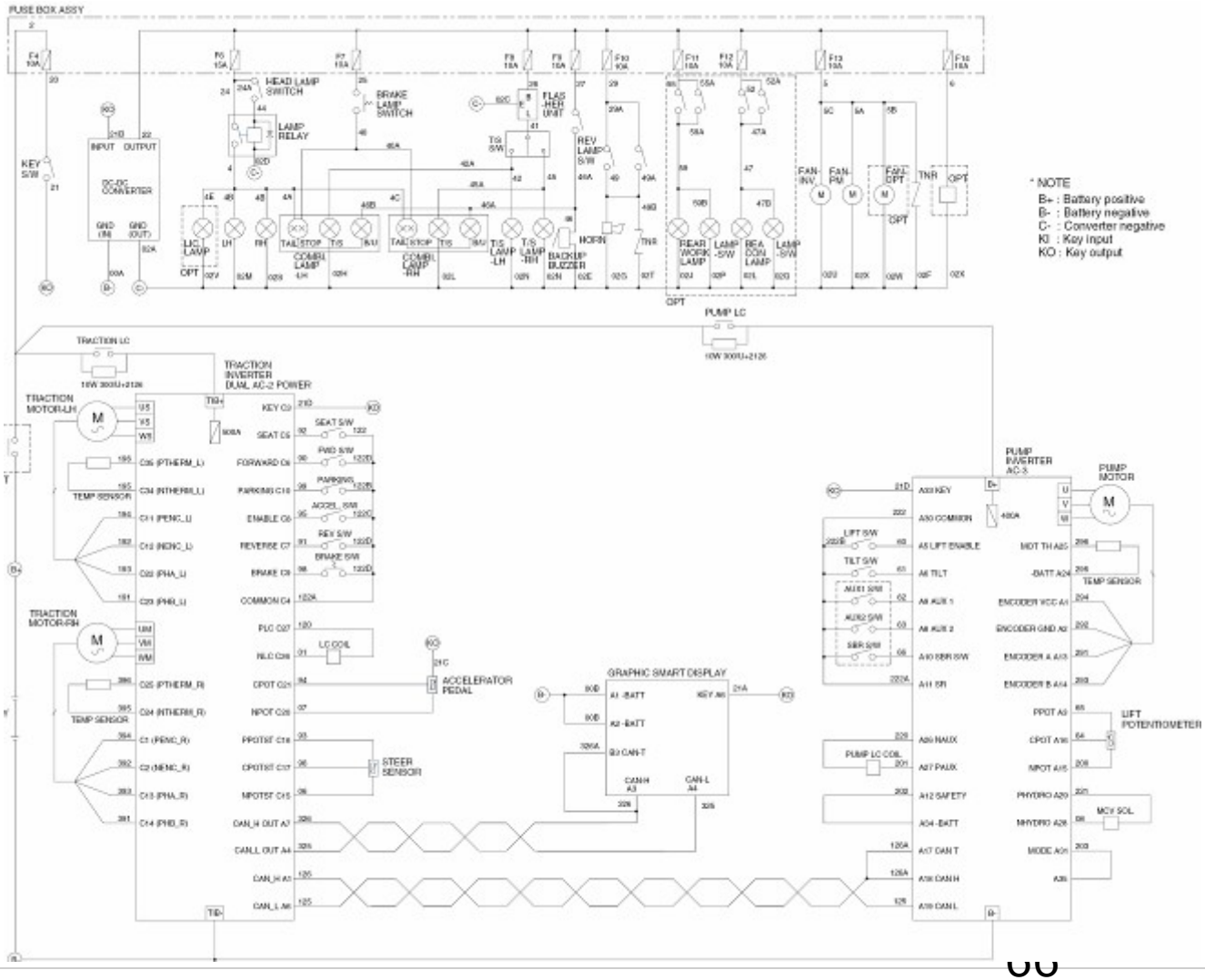
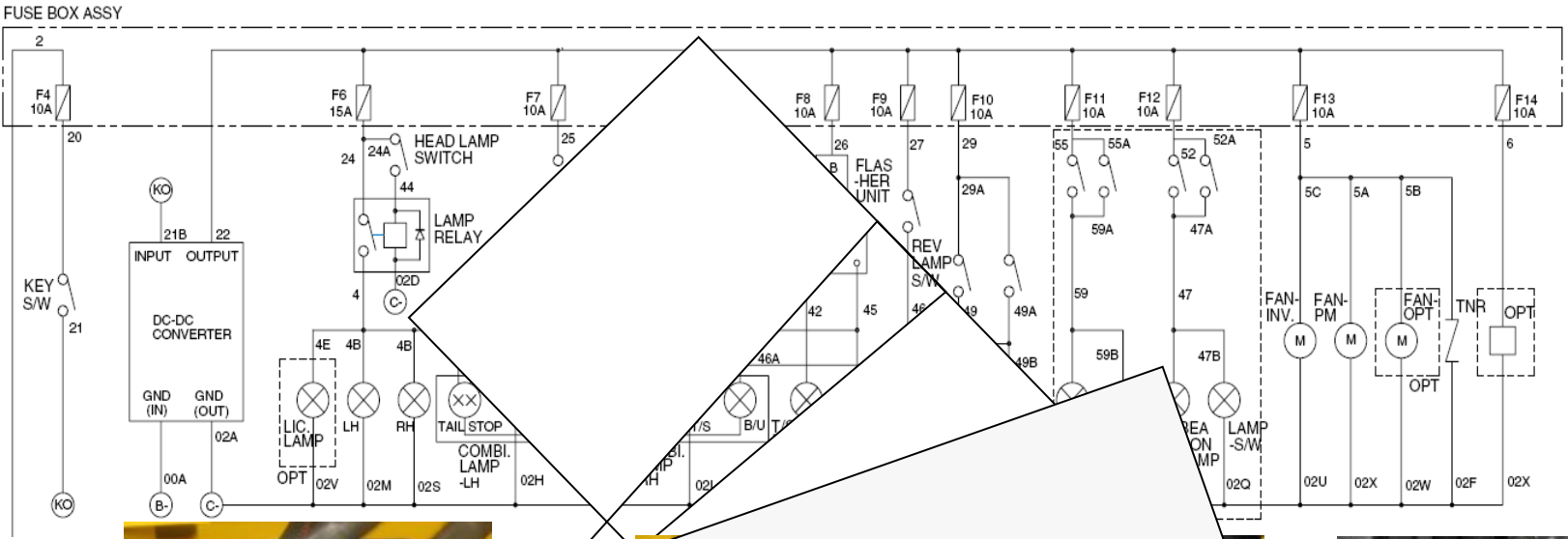
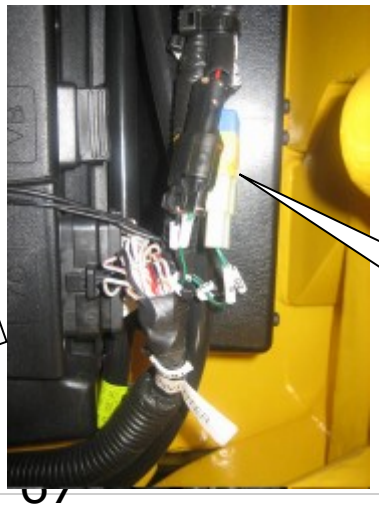
- 22/25/30/32B-7 Electric Diagram.

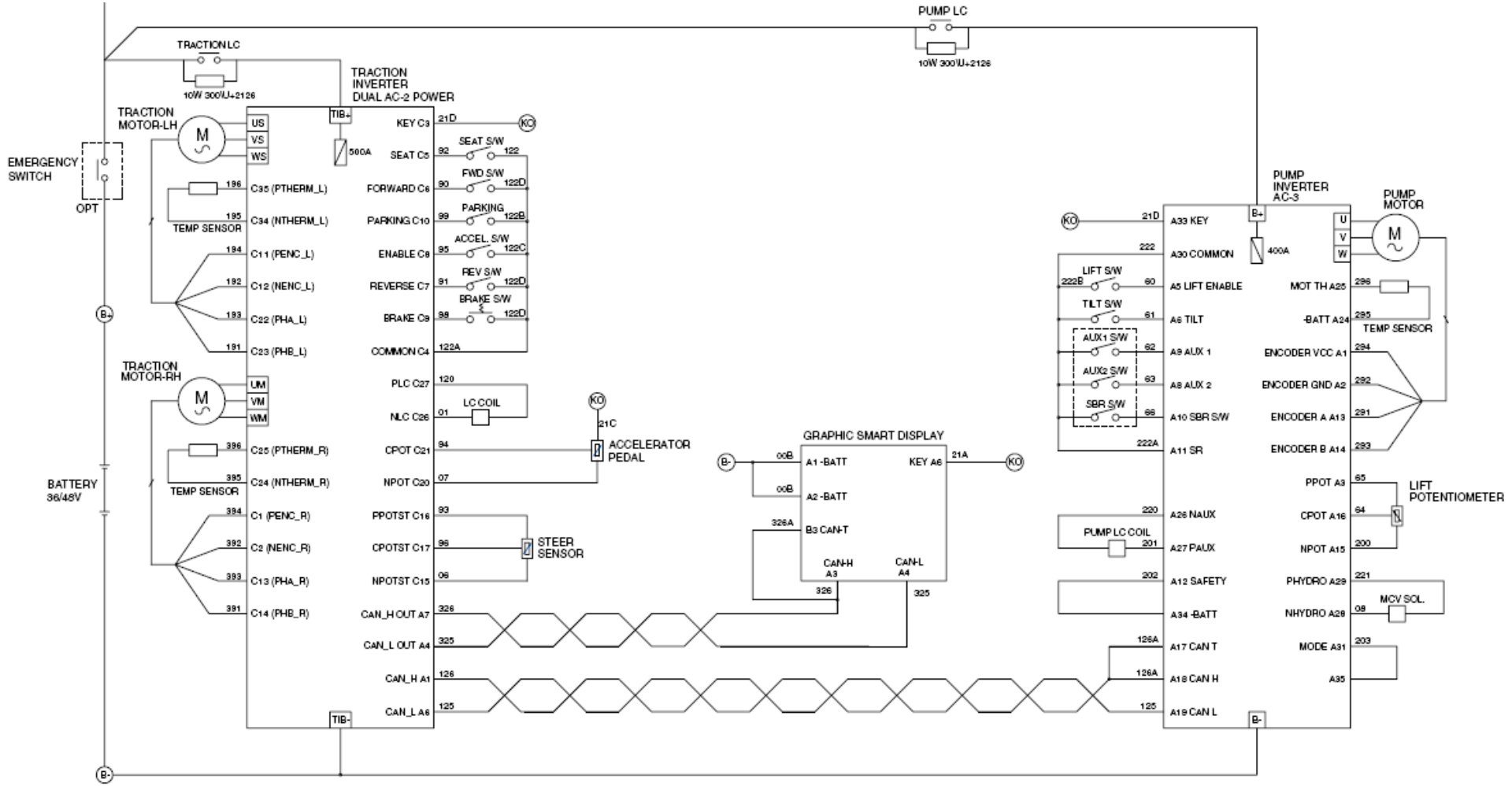


- 22/25/30/32B-7 DC System. (Behind converter)





- 22/25/30/32B-7 AC System.



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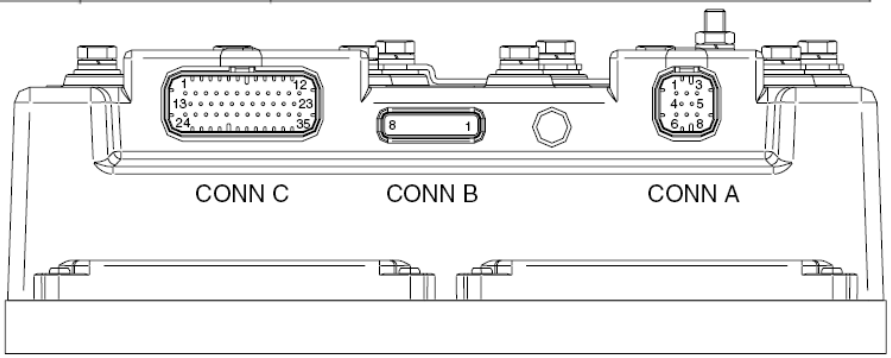
- 22/25/30/32B-7 Traction Con. Configuration.

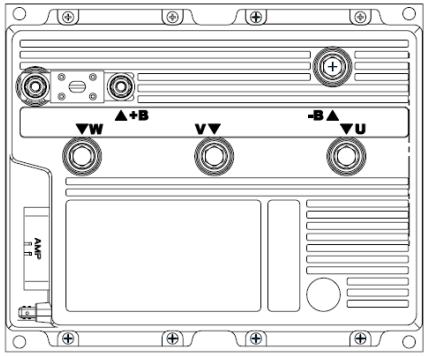
No. of Pin	Function	Description
A1	CAN_H	High level CANBUS.
A2	CANT_H	CANBUS termination output, 120 ohm internally connected to CAN_H. Connect to CAN_L_OUT to insert the termination.
A3	CAN_POS	Positive of CAN circuit; to be used in case of optoisolated CANBUS.
A4	CAN_L_OUT	Low level CANBUS: to be used as repetition for CAN_L line or to be connected to CANT_H to insert termination resistance.
A5	CANT_L	CANBUS termination output, 120 ohm internally connected to CAN_L. Connect to CAN_H_OUT to insert the termination.
A6	CAN_L	Low level CANBUS.
A7	CAN_H_OUT	High level CANBUS: to be used as repetition for CAN_ H line or to be connected to CANT_L to insert termination resistance.
A8	CAN_NEG.	Negative of CAN circuit, to be used in case of optoisolated CANBUS.
B1	PCLRXD	Positive serial reception.
B2	NCLRXD	Negative serial reception.
B3	PCLTXD	Positive serial transmission.
B4	NCLTXD	Negative serial transmission.
B5	GND	Negative console power supply.
B6	+12	Positive console power supply.
B7	FLASH	
B8	FLASH	
C1	PENC_R	Positive of right motor encoder power supply (+5 V/+12 V).
C2	NENC_R	Negative of right motor encoder power supply.
C3	KEY	Connected to + batt trough a microswitch and a 10 A fuse in series.
C4	CM	Common of FW / REV / HB / PB / SEAT / ENABLE / SR / EX. HYDRO / BACKING microswitches.
C5	SEAT	Seat presence signal; active high.
C6	FORWARD	Forward direction request signal; active high.
C7	REVERSE	Reverse direction request signal; active high.
C8	ENABLE/BACK.	Traction or backing request signal; active high.
C9	PB	Pedal brake request signal; active high.
C10	SR/HB/EX. HYDRO	Speed reduction signal or hand brake or exclusive hydro input; active low (microswitch open). See also page 7-24.
C11	PENC_L	Positive of left motor encoder power supply (+5 V/+12 V).
C12	NENC_L	Negative of left motor encoder power supply.
C13	PHA_R	Right motor encoder phase A.
C14	PHB_R	Right motor encoder phase B.
C15	NPOTST	Negative of steering potentiometer (-BATT).
C16	PPOTST	Positive of steering potentiometer (+5 V/+12 V).
C17	CPOTST	Steering potentiometer wiper signal.
C18	CPOTB	Brake potentiometer wiper signal.

Model	Model	Application	Type	Power	Current limit
22/25/30/32B-7	DUAL AC2 Power	Traction	MOSFET	36-48V, 450+450A	450A/3min
	AC3	Pump	MOSFET	36-48V, 600A	600A/3min

No. of Pin	Function	Description
C19	NPOTB	-BATT.
C20	NPOT	Negative of traction accelerator potentiometer, tested for wire is connection diagnosis.
C21	CPOT	Traction potentiometer wiper signal.
C22	PHA_L	Left motor encoder phase A.
C23	PHB_L	Left motor encoder phase B.
C24	NTHERM_R	Negative of right traction motor temperature sensor.
C25	PTHERM_R	Right traction motor temperature signal.
C26	NLC	Output of main contactor coil driver (drives to -BATT).
C27	PLC	Positive of main contactor coil.
C28	NBRAKE	Output of electric brake coil; drives the load to -BATT, maximum current 3 A.
C29	PBRAKE	Positive of the electromechanical brake coil.
C30	PAUX	Positive of auxiliary load.
C31	NAUX	Output of auxiliary load driver (drives to -BATT).
C32	-BATT	
C33	PPOT	Traction/brake potentiometer positive, 5/10 V output; use load > 1 kohm.
C34	NTHERM_L	Negative of left traction motor temperature sensor.
C35	PTHERM_L	Left traction motor temperature signal.



- 22/25/30/32B-7 Pump Con. Configuration.



No. of pin	Function	Description
A1	+12V (+5V)	Positive of encoder power supply.
A2	ENC GND	Negative of encoder power supply.
A3	PPOT	Lift potentiometer positive: 10V output; keep load > 1kΩ.
A4	DIG. IN.	Spare digital input; it is active HIGH.
A5	LIFT ENABLE	Input for potentiometer lifting enable input; it is active HIGH.
A6	TILT UP/DOWN	Input for tilt up and tilt down digital input; it is active HIGH.
A7	DIG. IN.	Spare digital input; it is active HIGH.
A8	AUX IN/OUT	Input for aux in and aux out digital input; it is active HIGH.
A9	SHIFT RGT/LFT	Input for shift right and shift left digital input; it is active HIGH.
A10	SBR	Input for side battery removal digital input; Active low.
A11	SR	Speed reduction input. Active low.
A12	SAFETY	If not connected to -batt the MC coil power output will be disabled. It can also be used as a general purpose input.
A13	ENC A	Phase A of encoder.
A14	ENC B	Phase B of encoder.
A15	NPOT	Negative of accelerator unit, tested for wire disconnection diagnosis.
A16	CPOT	Lift potentiometer wiper.
A17	CAN T	CAN termination; connect to CAN H (A18) to insert can termination resistance.

No. of pin	Function	Description
A18	CAN H	High level CAN-BUS voltage I/O.
A19	CAN L	Low level CAN-BUS voltage I/O.
A20	NPOT-AUX	-Batt.
A21	CPOT-AUX	Free analog input.
A22	ENC A*	Phase A inverted of encoder (encoder with differential output).
A23	ENC B*	Phase B inverted of encoder (encoder with differential output).
A24	-BATT	-Batt.
A25	MOT TH	Input for motor temperature sensor.
A26	NLC	Pump line contactor output.
A27	PLC	Positive of the line contactor output.
A28	NAUX	Spare output.
A29	PAUX	Positive for output A28. Spare.
A30	CM	Common of digital microswitches.
A31	MODE	This input allows the customer to select the software for traction or lifting application. To be connected with A35.
A32	PPOT-AUX	Auxiliary potentiometer positive: 10V output; keep load> 1kΩ.
A33	KEY	Connected to the power supply through a microswitch(CH) with a 10A fuse in series.
A34	-BATT	-Batt.
A35	-BATT	-Batt.
B1	PCLRXD	Positive serial reception.
B2	NCLRXD	Negative serial reception.
B3	PCLTXD	Positive serial transmission.
B4	NCLTXD	Negative serial transmission.
B5	GND	Negative console supply.
B6	+12V	Positive console supply.
B7	FLASH	It must be connected to B8 for the flash memory programming.
B8	FLASH	It must be connected to B7 for the flash memory programming.

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- 22/25/30BHA-7 Electric Component location.

1 Combination switch

2 Accelerator assy

3 Parking micro switch

4 High horn

5 Drive motor

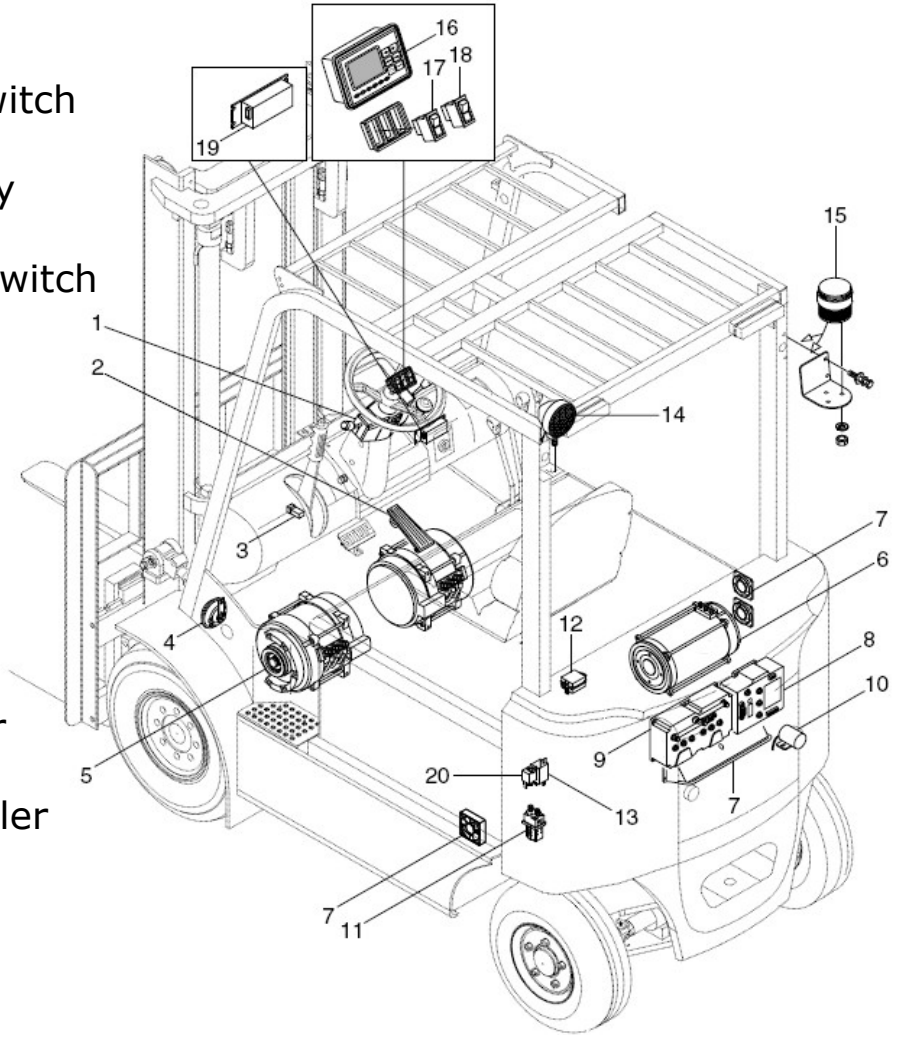
6 Pump motor

7 Fan assy

8 Pump controller

9 Traction controller

10 Back up alarm



11 Contactor

12 Fuse box assy

13 Flasher unit assy

14 Working lamp (opt)

15 Beacon lamp (opt)

16 Display

17 Working lamp switch (opt)

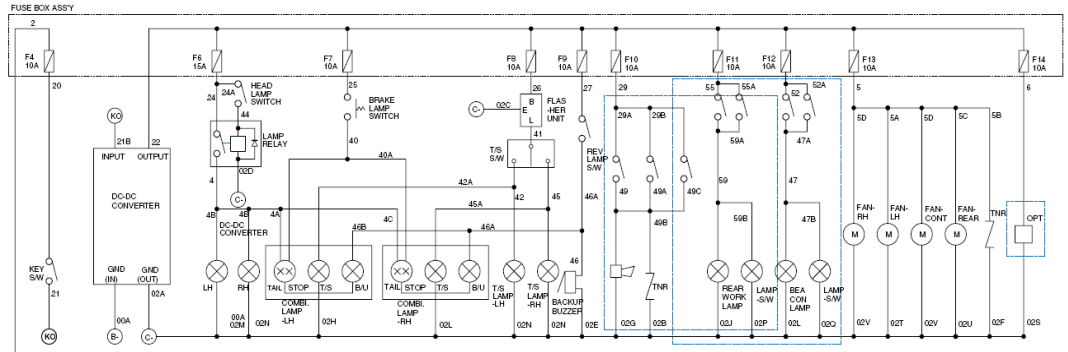
18 Beacon lamp switch (opt)

19 DC-DC converter

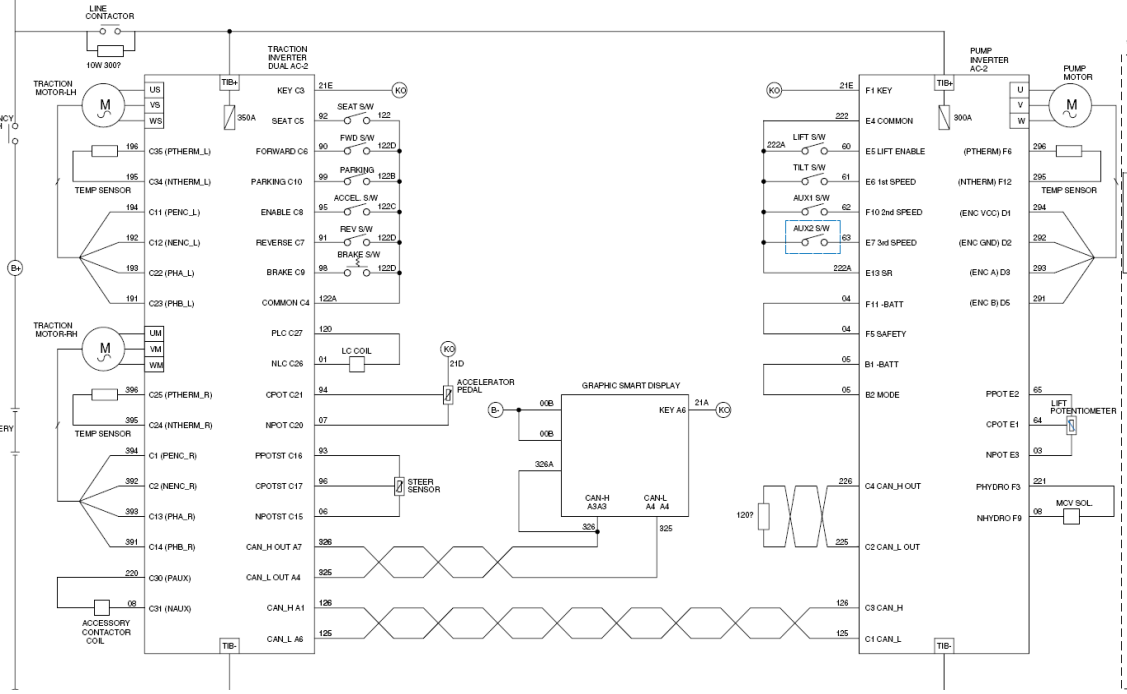
20 Relay

71

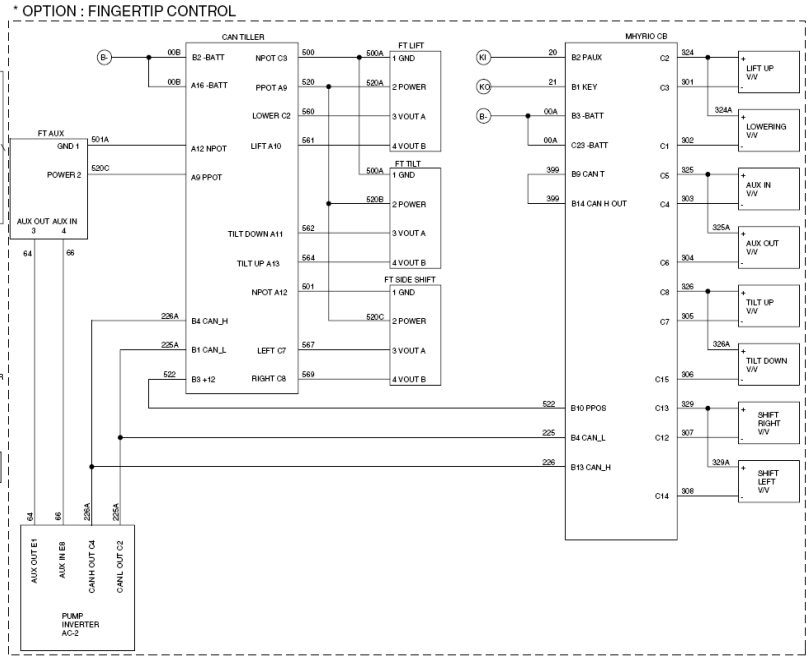
- 22/25/30BHA-7 Electric Diagram.



* NOTE
B+ : Battery positive
B- : Battery negative
C- : Converter output negative
KI : Key switch input
KO : Key switch output



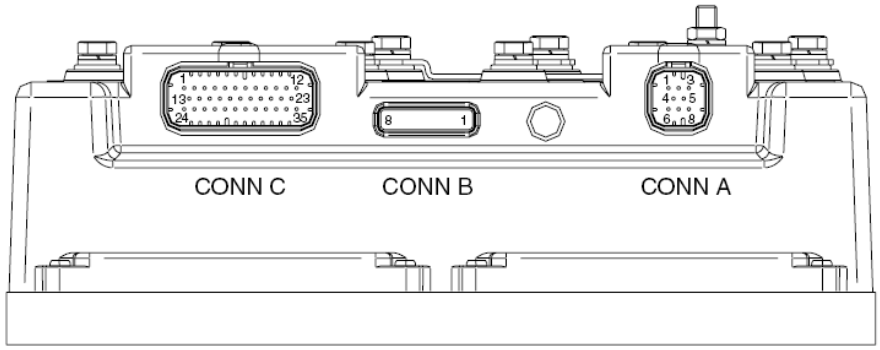
* OPTION : FINGERTIP CONTROL



- 22/25/30BHA-7 Traction Con. Configuration.

No. of Pin	Function	Description
A1	CAN_H	High level CANBUS.
A4	CAN_L_OUT	Low level CANBUS: to be used as repetition for CAN_L line or to be connected to CANT_H to insert termination resistance.
A6	CAN_L	Low level CANBUS.
A7	CAN_H_OUT	High level CANBUS: to be used as repetition for CAN_ H line or to be connected to CANT_L to insert termination resistance.
B1	PCLRXD	Positive serial reception.
B2	NCLRXD	Negative serial reception.
B3	PCLTXD	Positive serial transmission.
B4	NCLTXD	Negative serial transmission.
B5	GND	Negative console power supply.
B6	+12	Positive console power supply.
B7	FLASH	
B8	FLASH	
C1	PENC_R	Positive of right motor encoder power supply (+5 V/+12 V).
C2	NENC_R	Negative of right motor encoder power supply.
C3	KEY	Connected to + batt trough a microswitch and a 10 A fuse in series.
C4	CM	Common of FW / REV / HB / PB / SEAT / ENABLE / SR / EX. HYDRO / BACKING microswitches.
C5	SEAT	Seat presence signal; active high.
C6	FORWARD	Forward direction request signal; active high.
C7	REVERSE	Reverse direction request signal; active high.
C8	ENABLE/BACK.	Traction or backing request signal; active high.
C9	BRAKE	Pedal brake request signal; active high.
C10	PARKING	Hand brake input; active low (microswitch open). See also page 7-24.
C11	PENC_L	Positive of left motor encoder power supply (+5 V/+12 V).
C12	NENC_L	Negative of left motor encoder power supply.
C13	PHA_R	Right motor encoder phase A.
C14	PHB_R	Right motor encoder phase B.
C15	NPOTST	Negative of steering potentiometer (-BATT).
C16	PPOTST	Positive of steering potentiometer (+5 V/+12 V).
C17	CPOTST	Steering potentiometer wiper signal.
C20	NPOT	Negative of traction accelerator potentiometer, tested for wire is connection diagnosis.
C21	CPOT	Traction potentiometer wiper signal.
C22	PHA_L	Left motor encoder phase A.
C23	PHB_L	Left motor encoder phase B.
C24	NTHERM_R	Negative of right traction motor temperature sensor.
C25	PTHERM_R	Right traction motor temperature signal.
C26	NLC	Output of main contactor coil driver (drives to -BATT).
C27	PLC	Positive of main contactor coil.
C34	NTHERM_L	Negative of left traction motor temperature sensor.
C35	PTHERM_L	Left traction motor temperature signal.

Model	Model	Application	Type	Power	Current limit
22/25/30BHA-7	DUAL AC2 Power	Traction	MOSFET	80V, 300+300A	300A/3min
	AC2 Power	Pump	MOSFET	80V, 400A	400A/3min



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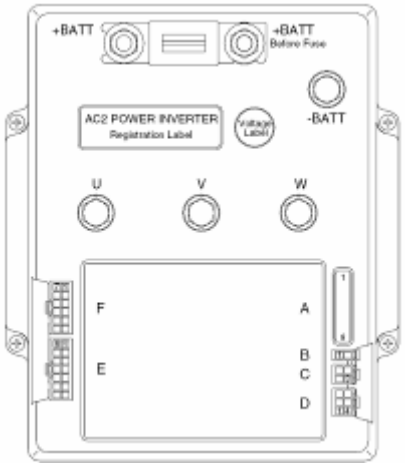
- 22/25/30BHA-7 Pump Con. Configuration.

No. of pin	Function	Description
A1	PCLRXD	Positive serial reception.
A2	NCLRXD	Negative serial reception.
A3	PCLTXD	Positive serial transmission.
A4	NCLTXD	Negative serial transmission.
A5	GND	Negative console power supply.
A6	+12	Positive console power supply.
A7	FLASH	Must be connected to A8 for the flash memory programming (if used).
A8	FLASH	Must be connected to A7 for the flash memory programming (if used).
B1	-BATT	-Batt.
B2	MODE	This input allows the customer to select the software in case of double version.
C1	CAN-L	Low level CAN-BUS voltage I/O.
C2	CAN-L-OUT	Low level CAN-BUS voltage I/O.
C3	CAN-H	High level CAN-BUS voltage I/O.
C4	CAN-H-OUT	High level CAN-BUS voltage I/O.



No. of pin	Function	Description
D1÷D6		Incremental ENCODER connector.
E1	CPOT	Accelerator potentiometer wiper.
E2	PPOT	Potentiometer positive: 10V output; keep load > 1KW.
E3	NPOT	Negative of accelerator unit, tested for wire disconnection diagnosis.
E4	CM	Common of LIFT ENABLE / 1st SPEED / 2nd SPEED / 3rd SPEED / 4th SPEED / HYDRO / SR microswitches.
E5	LIFT ENABLE	Input for potentiometer lifting enable input; it is active HIGH.
E6	1st SPEED	Input for first speed request; it is active HIGH.
E7	3rd SPEED	Input for third speed request; it is active HIGH.
E13	SR	Speed reduction input. Active low (switch opened).
F1	KEY	Connected to the power supply through a microswitch (CH) with a 10A fuse in series.
F3	PHYDRO	Positive for the hydraulic steering contactor.
F5	SAFETY	If not connected to -batt the MC coil power output will be disabled. Can also be used as a general purpose input.
F6	PTHERM	Input for motor temperature sensor.
F9	NHYDRO	Auxiliary output; drives the load to -batt. maximum current: 3A.
F10	2nd SPEED	Input for second speed request; it is active HIGH.
F11	GND	-Batt.
F12	NTHERM	-Batt.

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- 35/40/45/50B-7 Electric systems.

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- 35/40/45/50B-7 Component location.

1 Combination switch

2 Accelerator assy.

3 Drive motor

4 Pump motor

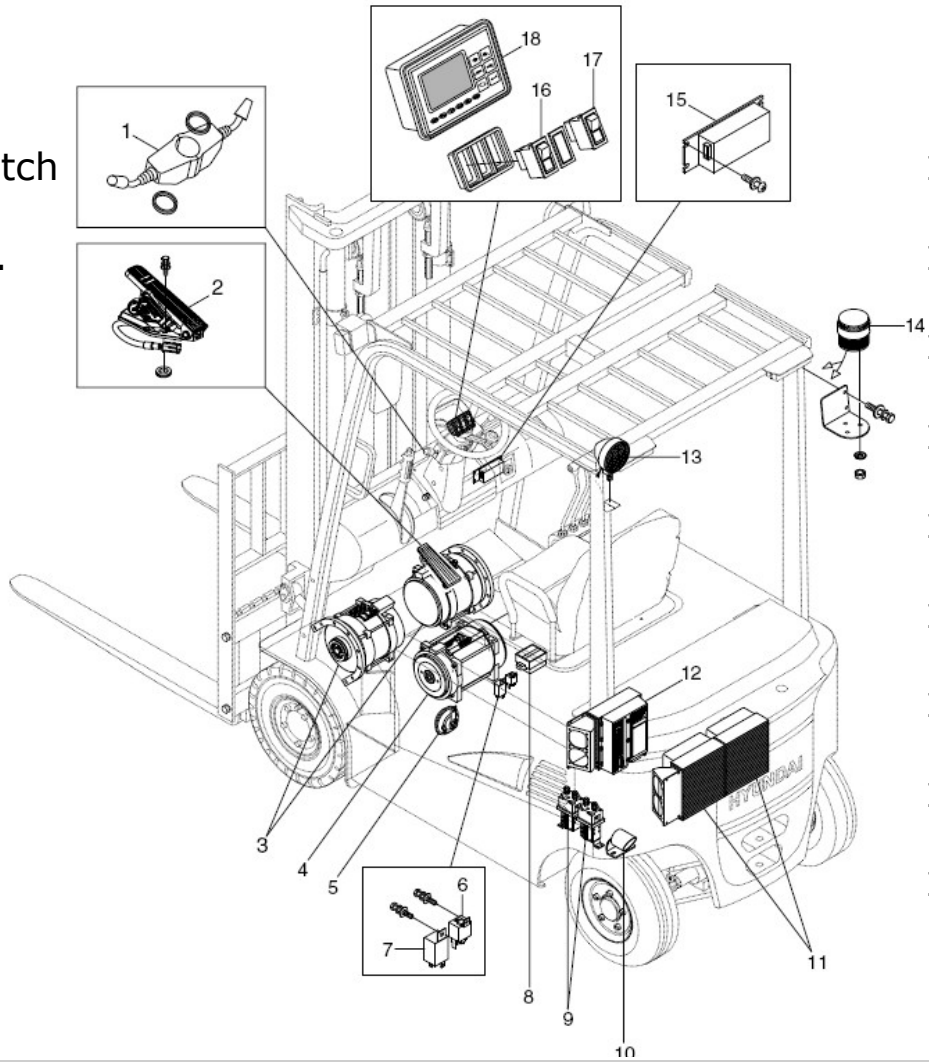
5 High horn

6 Relay

7 Flasher unit

8 Fuse box assy

9 Contactor



10 Back buzzer

11 Traction controller

12 Pump controller

13 Rear work lamp (Opt)

14 Beacon lamp (Opt)

15 DC-DC converter

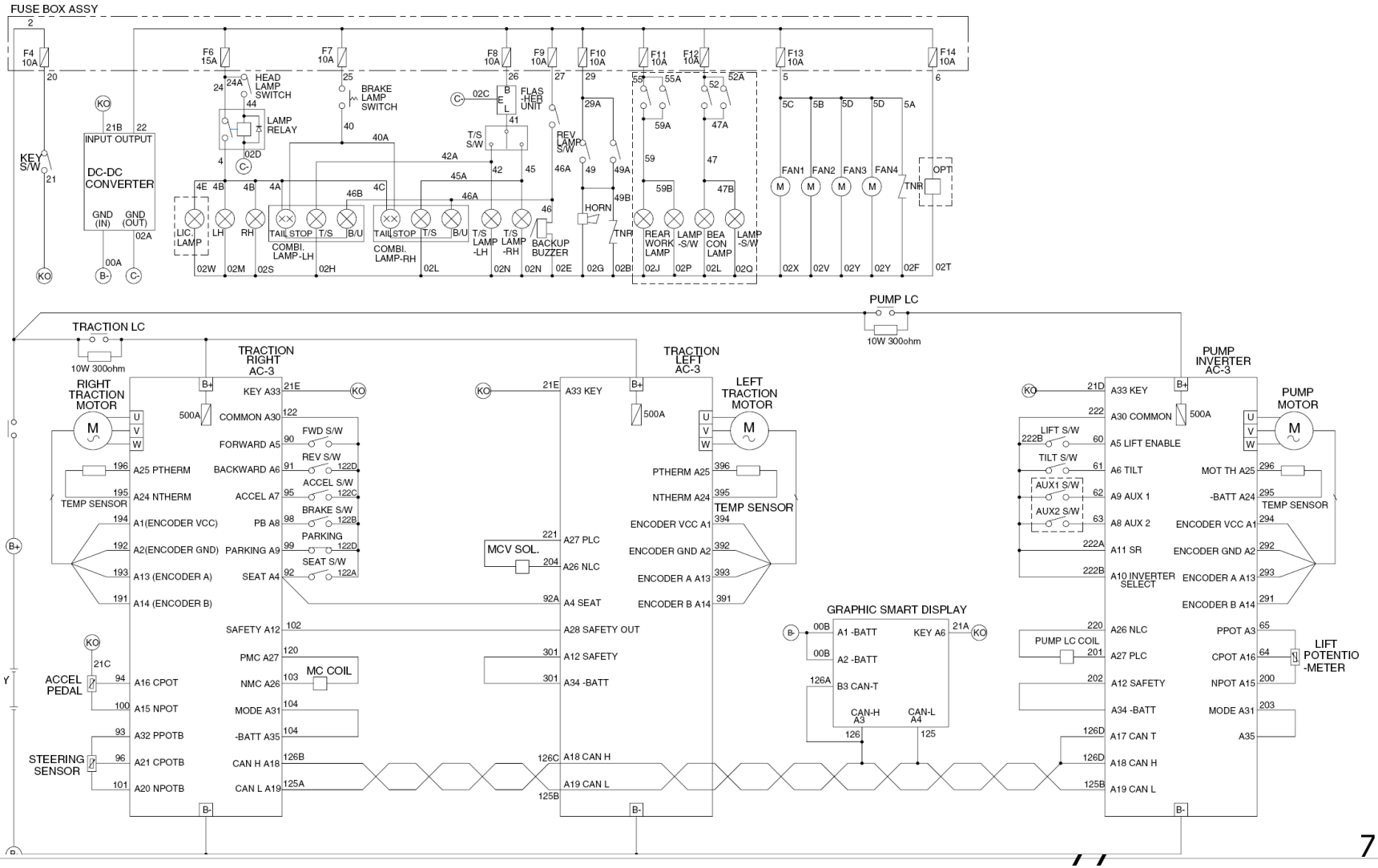
16 Working lamp switch (Opt)

17 Beacon lamp switch (Opt)

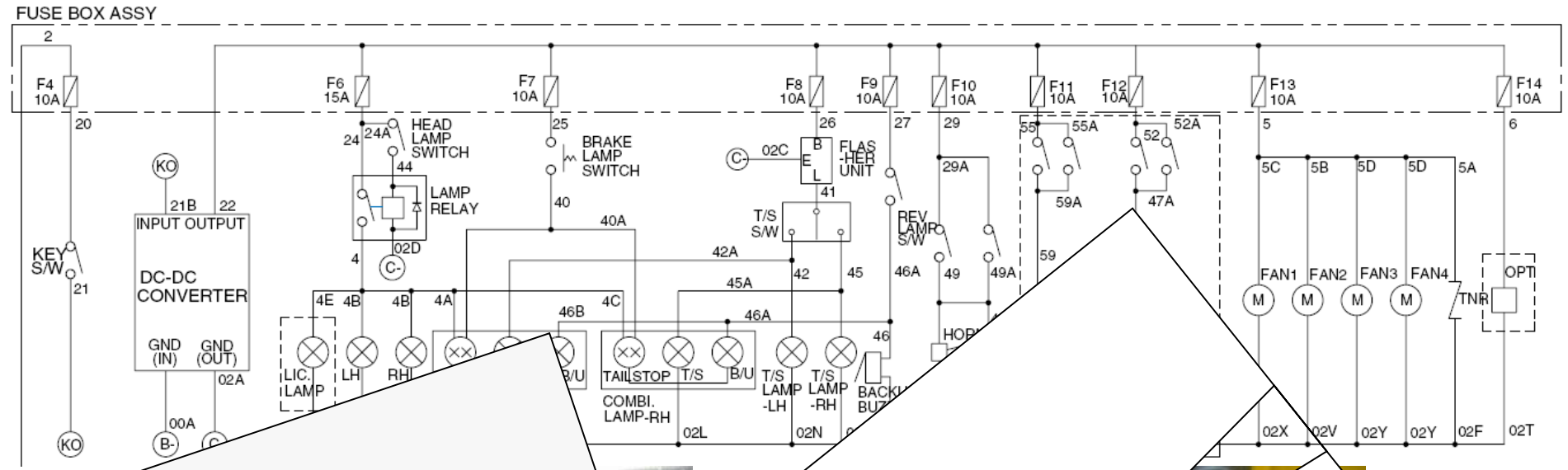
18 Display

76

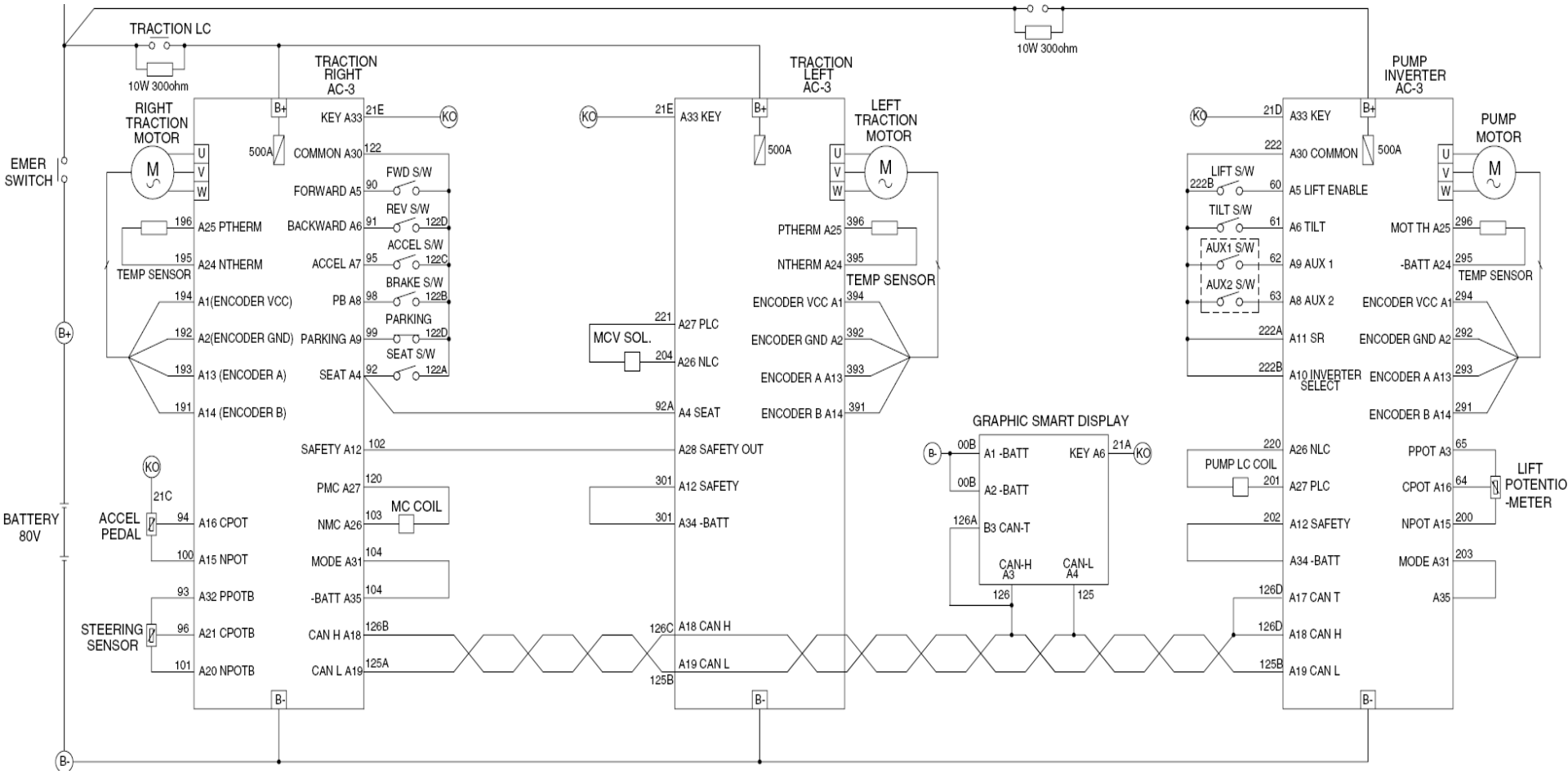
- 35/40/45/50B-7 Electric Diagram.



- 35/40/45/50B-7 DC System. (Behind converter)



- 35/40/45/50B-7 AC System.



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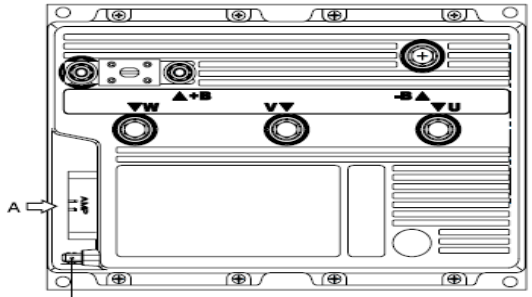
- 35/40/45/50B-7 Traction Master Configuration.

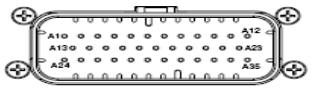
Model	Model	Application	Type	Power	Current limit
35/40/45/50B-7	AC3	Traction	MOSFET	80V, 600A	600A/3min
	AC3	Pump	MOSFET	80V, 600A	600A/3min

No. of Pin	Function	Description
A1	+12V (+5V)	Positive of encoder power supply.
A2	+12V (+5V)	Negative of encoder power supply.
A4	SEAT	SEAT input; it must be connected to the SEAT microswitch; it is active high.
A5	FORWARD	Forward direction request input. It must be connected to the forward direction microswitch, active high.
A6	BACKWARD	Backward direction request input. It must be connected to the backward direction microswitch, active high.
A7	EX.HYDRO/ENABLE	Exclusive hydro or accelerator enable function input. It must be connected to the exclusive hydro microswitch or to the accelerator enable switch. Active high.
A8	PB	Brake request input. It must be connected to the brake pedal switch, active high.
A9	SR/HB	Speed reduction(handbrake) input. Active low(switch opened).
A12	SAFETY	If not connected to -Batt the MC coil power output will be disabled. It can also be used as a general purpose input.
A13	ENC A	Phase A of encoder.
A14	ENC B	Phase B of encoder.
A15	NPOT	Negative of accelerator unit, tested for wire disconnection diagnosis.
A16	CPOT	Accelerator potentiometer wiper.
A18	CAN H	High level CAN-BUS voltage I/O.
A19	CAN L	Low level CAN-BUS voltage I/O.
A20	NPOTB	-Batt.
A21	CPOTB	Steering potentiometer wiper.
A24	NTHERM	-Batt.
A25	PTHERM	Input for motor temperature sensor.
A26	NMC	Negative of main contactor coil.
A27	PMC	Positive of main contactor coil.
A30	CM	Common of FW / BW / SR / PB / SEAT / BACK. FW / BACK. BW / EXCLUSIVE HYDRO / ENABLE microswitches.
A31	MODE	MODE: Closed(connected with A35): Traction master.
A32	PPOTB	Steering potentiometer positive. 10V output; keep load > 1 kW
A33	KEY	Connected to the power supply through a microswitch (CH) with a 10A fuse in series.
A34	-BATT	-Batt.
B1	PCLRXD	Positive serial reception.
B2	NCLRXD	Negative serial reception.
B3	PCLTXD	Positive serial transmission.
B4	NCLTXD	Negative serial transmission.
B5	GND	Negative console power supply.

A30	CM	Common of FW / BW / SR / PB / SEAT / BACK. FW / BACK. BW / EXCLUSIVE HYDRO / ENABLE microswitches.
A31	MODE	MODE: Closed(connected with A35): Traction master.
A32	PPOTB	Steering potentiometer positive. 10V output; keep load > 1 kW
A33	KEY	Connected to the power supply through a microswitch (CH) with a 10A fuse in series.
A34	-BATT	-Batt.
B1	PCLRXD	Positive serial reception.
B2	NCLRXD	Negative serial reception.
B3	PCLTXD	Positive serial transmission.
B4	NCLTXD	Negative serial transmission.
B5	GND	Negative console power supply.

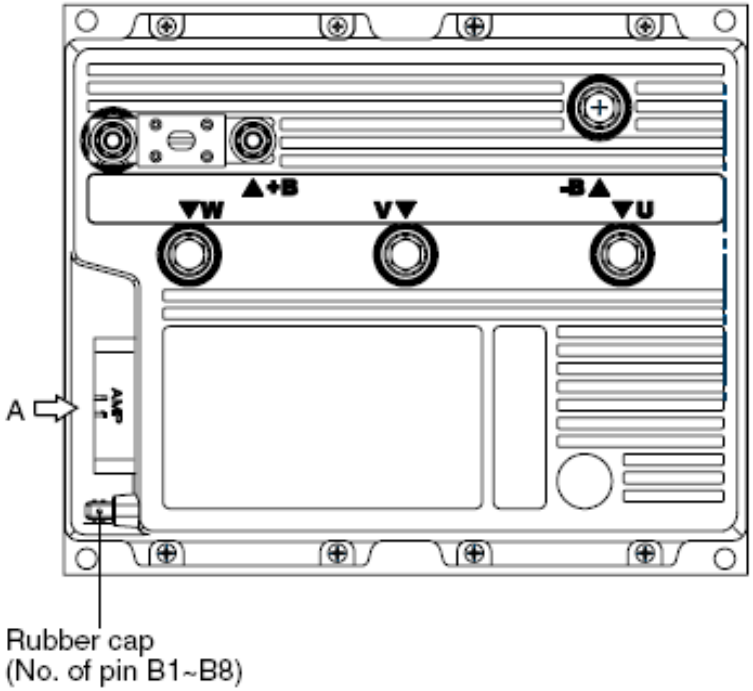
No. of Pin	Function	Description
B6	+12	Positive console power supply.
B7	FLASH	It must be connected to B8 for the Flash memory programming.
B8	FLASH	It must be connected to B7 for the Flash memory programming.

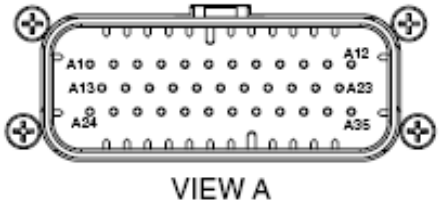




- 35/40/45/50B-7 Traction Slave Configuration.

No. of Pin	Function	Description
A1	+12V (+5V)	Positive of encoder power supply.
A2	+12V (+5V)	Negative of encoder power supply.
A4	SEAT	SEAT input; it must be connected to the SEAT microswitch; it is active high.
A12	SAFETY	If not connected to -Batt the MC coil power output will be disabled. It can also be used as a general purpose input.
A13	ENC A	Phase A of encoder.
A14	ENC B	Phase B of encoder.
A18	CAN H	High level CAN-BUS voltage I/O.
A19	CAN L	Low level CAN-BUS voltage I/O.
A24	NTHERM	-Batt.
A25	PTHERM	Input for motor temperature sensor.
A26	NMC	Negative of MCV sol coil.
A27	PMC	Positive of MCV sol coil.
A28	SAFETY	If not connected to -Batt the MC coil power output will be disabled. It can also be used as a general purpose input.
A31	MODE	Open(No connection): Traction slave.
A33	KEY	Connected to the power supply through a microswitch (CH) with a 10A fuse in series.
A34	-BATT	-Batt.
B1	PCLRXD	Positive serial reception.
B2	NCLRXD	Negative serial reception.
B3	PCLTXD	Positive serial transmission.
B4	NCLTXD	Negative serial transmission.
B5	GND	Negative console power supply.
B6	+12	Positive console power supply.
B7	FLASH	It must be connected to B8 for the Flash memory programming.
B8	FLASH	It must be connected to B7 for the Flash memory programming.





VIEW A

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- 35/40/45/50B-7 Pump Con. Configuration.

No. of pin	Function	Description
A1	+12V (+5V)	Positive of encoder power supply.
A2	ENC GND	Negative of encoder power supply.
A3	PPOT	Lift potentiometer positive: 10V output; keep load > 1kΩ.
A5	LIFT ENABLE	Input for potentiometer lifting enable input; it is active HIGH.
A6	TILT UP/DOWN	Input for tilt up and tilt down digital input; it is active HIGH.
A7	DIG. IN.	Spare digital input; it is active HIGH.
A8	AUX IN/OUT	Input for aux in and aux out digital input; it is active HIGH.
A9	SHIFT RGT/LFT	Input for shift right and shift left digital input; it is active HIGH.
A10	INVERTER SELECT	Closed: Pump.
A11	SR	Speed reduction input. Active low.
A12	SAFETY	If not connected to -batt the MC coil power output will be disabled. It can also be used as a general purpose input.
A13	ENC A	Phase A of encoder.
A14	ENC B	Phase B of encoder.
A15	NPOT	Negative of accelerator unit, tested for wire disconnection diagnosis.
A16	CPOT	Lift potentiometer wiper.
A17	CAN T	CAN termination; connect to CAN H (A18) to insert can termination resistance.

No. of pin	Function	Description
A18	CAN H	High level CAN-BUS voltage I/O.
A19	CAN L	Low level CAN-BUS voltage I/O.
A24	-BATT	-Batt.
A25	MOT TH	Input for motor temperature sensor.
A26	NLC	Pump line contactor output.
A27	PLC	Positive of the line contactor output.
A30	CM	Common of digital microswitches.
A31	MODE	Closed: Pump. To be connected with A35.
A33	KEY	Connected to the power supply through a microswitch(CH) with a 10A fuse in series.
A34	-BATT	-Batt.
A35	-BATT	-Batt.
B1	PCLRXD	Positive serial reception.
B2	NCLRXD	Negative serial reception.
B3	PCLTXD	Positive serial transmission.
B4	NCLTXD	Negative serial transmission.
B5	GND	Negative console supply.
B6	+12V	Positive console supply.
B7	FLASH	It must be connected to B8 for the flash memory programming.
B8	FLASH	It must be connected to B7 for the flash memory programming.

No. of pin	Function	Description
A18	CAN H	High level CAN-BUS voltage I/O.
A19	CAN L	Low level CAN-BUS voltage I/O.
A24	-BATT	-Batt.
A25	MOT TH	Input for motor temperature sensor.
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A27	PLC	Positive of the line contactor output.
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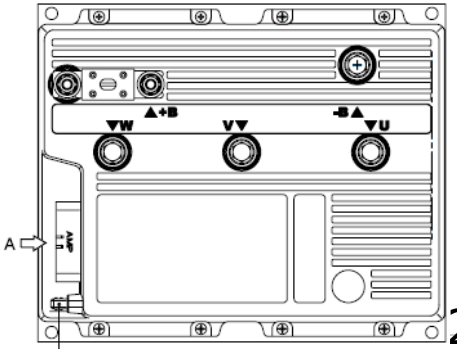
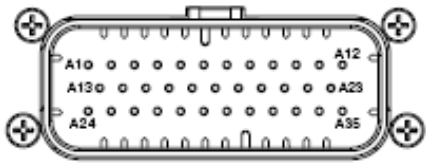
A31	MODE	Closed: Pump. To be connected with A35.
A33	KEY	Connected to the power supply through a microswitch(CH) with a 10A fuse in series.
A34	-BATT	-Batt.
A35	-BATT	-Batt.
B1	PCLRXD	Positive serial reception.
B2	NCLRXD	Negative serial reception.
B3	PCLTXD	Positive serial transmission.
B4	NCLTXD	Negative serial transmission.
B5	GND	Negative console supply.
B6	+12V	Positive console supply.
B7	FLASH	It must be connected to B8 for the flash memory programming.
B8	FLASH	It must be connected to B7 for the flash memory programming.





VIEW A

ZAPI controller systems

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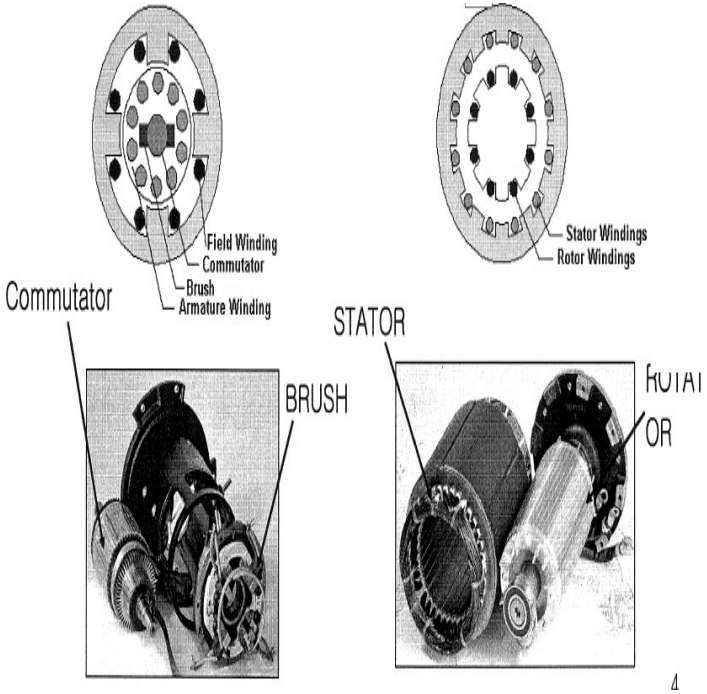
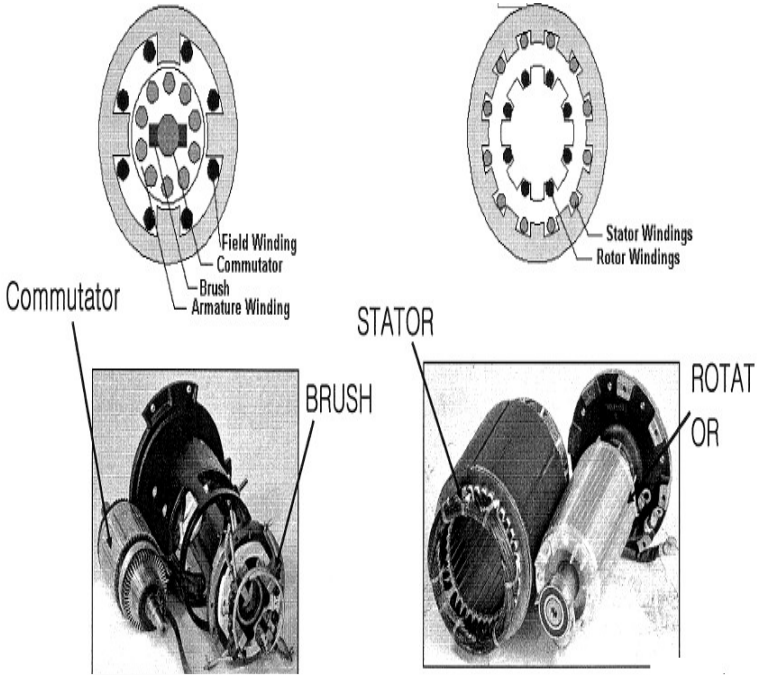
- Some basics.

DC Motor



- DC motors consist of rotor-mounted windings (armature) and stationary windings (field poles). In all DC motors, except permanent magnet motors, current must be conducted to the armature windings by passing current through carbon brushes that slide over a set of copper surfaces called a commutator, which is mounted on the rotor. The commutator bars are soldered to armature coils. The brush/commutator combination makes a sliding switch that energizes particular portions of the armature, based on the position of the rotor. This process creates north and south magnetic poles on the rotor that are attracted to or repelled by north and south poles on the stator, which are formed by passing direct current through the field windings. It's this magnetic attraction and repulsion that causes the rotor to rotate.

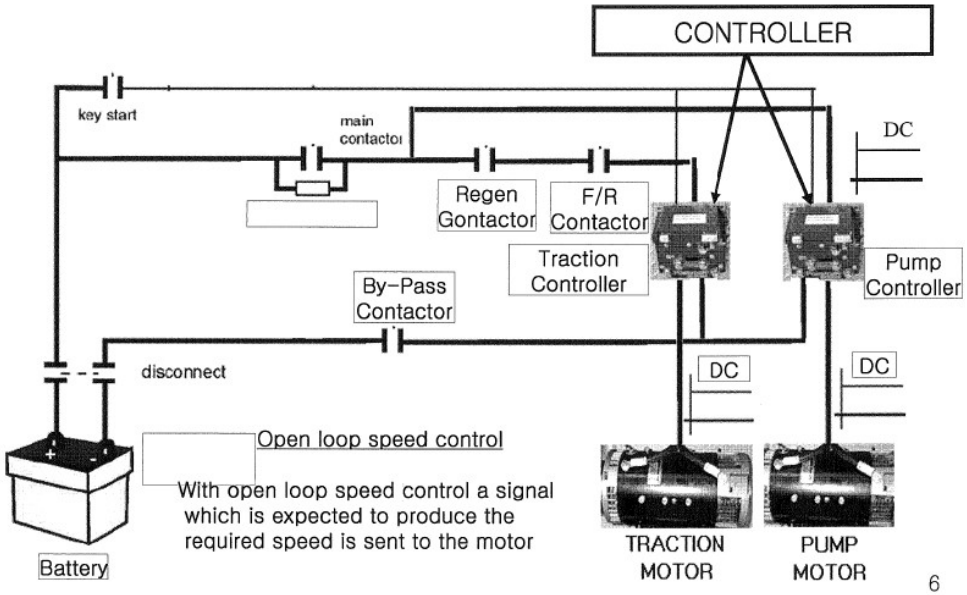
AC Motor



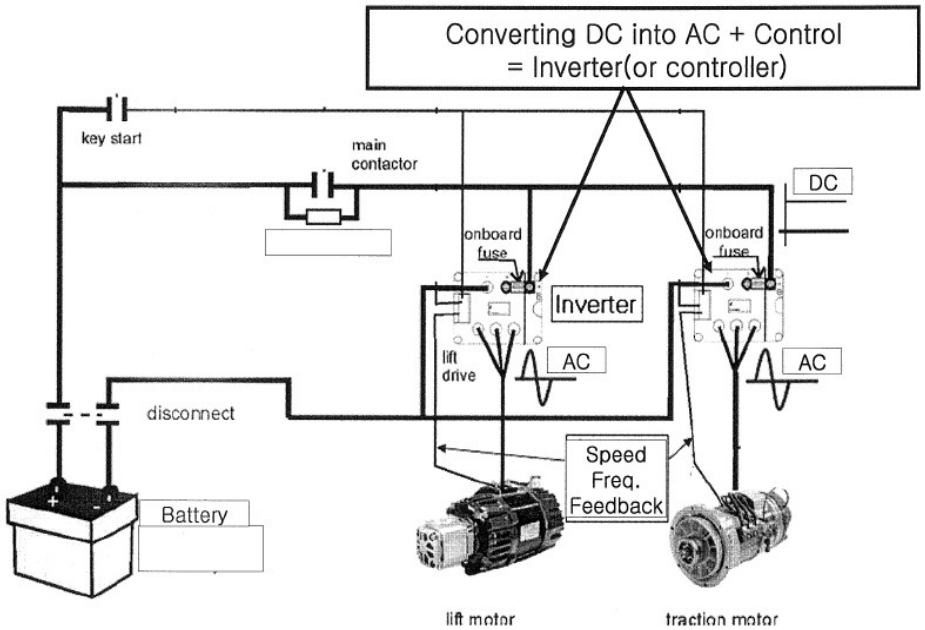
- A magnetic field is produced in an AC motor through the action of the three- phase voltage that is applied. Each of the three phases is 120° from the other phases. From one instant to the next, the magnetic fields combine to produce a magnetic field whose position shifts through a certain angle. At the end of one cycle of alternating current, the magnetic field will have shifted through 360°, or one revolution.
- Torque in an AC motor is developed through interactions with the rotor and the rotating magnetic field. The rotating magnetic field cuts the bars of the rotor and induces a current in them due to generator action. This induced current will produce a magnetic field around the conductors of the rotor, which will try to line up with the magnetic field of the stator.

- Some basics.

DC controller system



AC controller system



- In a open loop speed control system NO feedback signal from the motor returns to the controller. Only a speed requirement signal arrives at the controller.

- In a close loop speed control system a feedback signal is returned from the motor to the controller. If the speed doesn't match the requirements, the power output to the motor is automatically adjusted until the proper speed is reached.

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- Zapi Dual AC2 inverter / AC2 and AC3 inverter.

- Can drive (control) 2 traction motors.
- Controllers control voltage and frequency.
- Limited slip and current parameters.
- Analog (potentiometer) and digital (encoders) inputs available.
- Power (electro valves) and signal (Can bus) output available.
- Protected against: Battery polarity inversion, I/O connection errors, Overheating,…..

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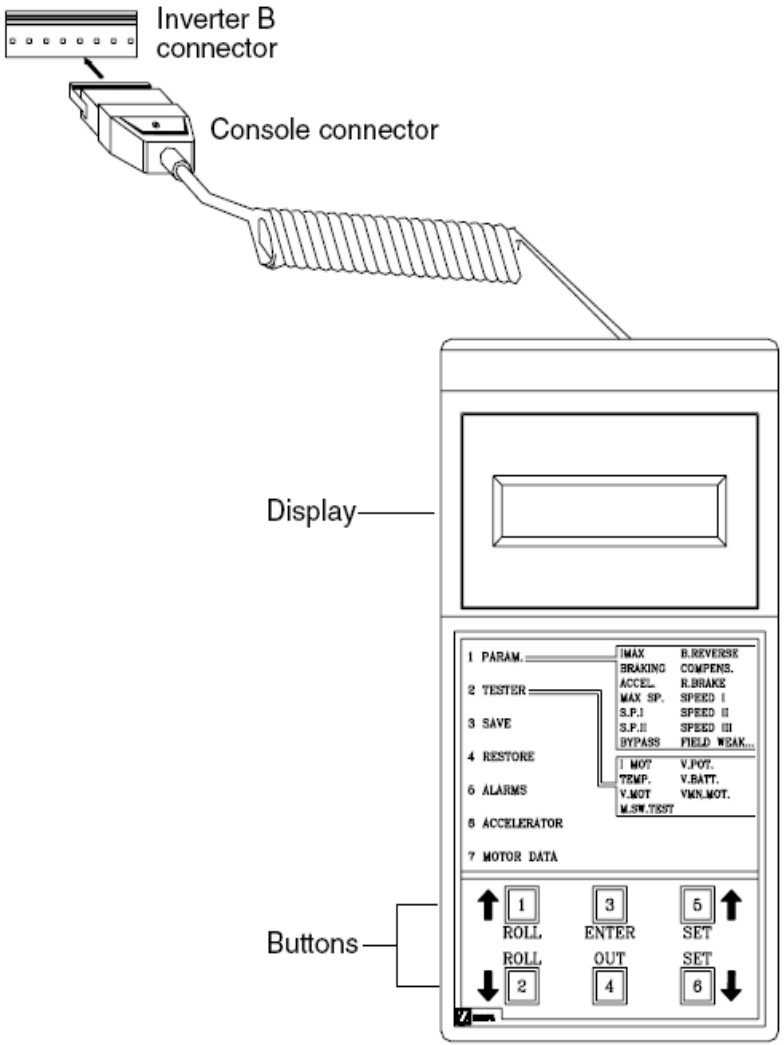
- Entering the system by Console.



"Set Options", Connect to possibilities

Number associated in canbus net	Module
03	TRACTION MASTER
04	TRACTION SLAVE
05	PUMP
09	MHYRIO (Option) (Fingertips)
16	GRAPHIC SMART DISPLAY

- Digital consoles used to communicate with AC inverter controllers must be fitted with EPROM CK ULTRA, minimum "Release number 3.02".

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- Enter the system with calibrator / Set Model – Option menu.

① Opening Zapi menu.

② Press ROLL UP & SET UP buttons to enter CONFIG MENU.

③ The display will show: SET MODEL. If another menu is displayed, press ROLL UP or ROLL DOWN until SET MODEL appears.

④ Press ENTER to go into the SET MODEL.

⑤ The display will shows the first option, only CONNECTED TO option is present in this menu.

⑥ Press SET UP or SET DOWN buttons in order to select the desired value for selected option.

⑦ New desired value appears.

⑧ Press OUT to exit the menu.

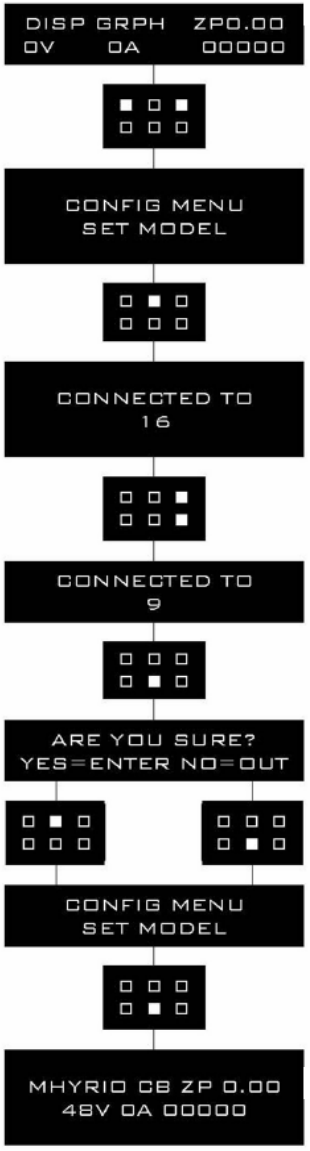
⑨ The display will ask "ARE YOU SURE?"

⑩ Press ENTER for YES, or OUT if you do not accept the changes.

⑪ SET MODEL menu appears.

⑫ Press OUT again. Console now disconnects and reconnects.

⑬ Display now shows the opening Zapi Menu of the ZAPI product corresponding to option selected at point 7.



Flow chart showing how to make changes to option menu:

① Opening Zapi menu.

② Press ROLL UP & SET UP Buttons to enter CONFIG MENU.

③ The display will show: SET MODEL.

④ Press ROLL UP or ROLL DOWN until SET OPTIONS appears.

⑤ SET OPTIONS menu appears.

⑥ Press ENTER to go into the SET OPTIONS menu.

⑦ The display will show the first option.

⑧ Press ROLL UP or ROLL DOWN buttons until desired option appears.

⑨ Desired option appears.

⑩ Press SET UP or SET DOWN buttons in order to modify the value for selected option.

⑪ New value for selected option appears.

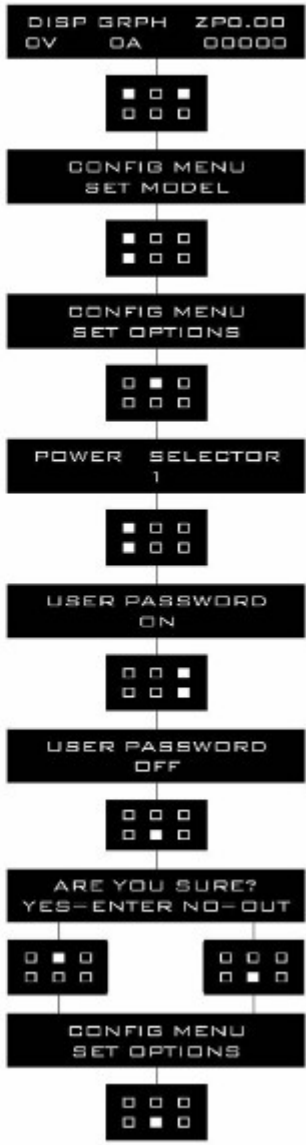
⑫ Press OUT to exit the menu.

⑬ Confirmation request appears.

⑭ Press ENTER to accept the changes, or press OUT if you do not accept the changes.

⑮ SET OPTIONS menu appears.

⑯ Press OUT again. Display now shows the opening Zapi menu.

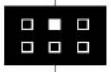


- Enter the system with calibrator / Saving – Restoring settings.

Flow chart showing how to use the SAVE function of the digital console.

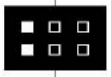
① Opening Zapi display.

② Press ENTER to go into the general menu.



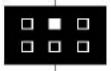
③ The display will show:

④ Press ROLL UP or ROLL DOWN button until SAVE PARAM. appear on the display.



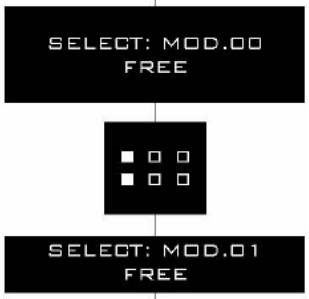
⑤ The display shows:

⑥ Press ENTER to go into the SAVE function.

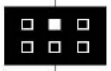


⑦ If this facility has been used before the type of chopper data stored appears on the top main with a 2 digit reference.

⑧ Keep pressing either ROLL UP or ROLL DOWN keys until the second Main indicates a FREE storage facility.



⑨ Press ENTER to commence SAVE routine.



⑩ You can see the items that are being stored whilst the SAVE routine is happening.

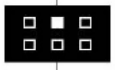
⑪ When finished, the console shows :

⑫ Press OUT to return to the opening Zapi display.

Flow chart showing how to use the RESTORE function of the digital console.

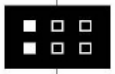
① Opening Zapi display.

② Press ENTER to go into the general menu.



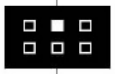
③ The display will show:

④ Press ROLL UP or ROLL DOWN button until SAVE PARAM. appear on the display.



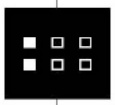
⑤ The display shows:

⑥ Press ENTER to go into the RESTORE PARAM function.

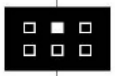


⑦ The display shows the type of model stored, with a code number.

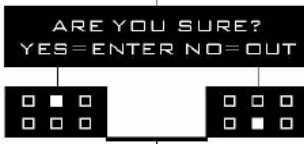
⑧ Keep pressing either ROLL UP or ROLL DOWN keys until the desired model appears on the display.



⑨ Press ENTER to commence restore operation.



⑩ The display asks "ARE YOU SURE?".



⑪ You can see the items that are being stored in the chopper memory whilst the RESTORE 'ine is happening

⑫ When finished, the console shows :

⑬ Press OUT to return to the opening Zapi display.

- Enter the system with calibrator / Test – Alarm menu.

Flow chart showing how to use the TESTER function of the digital console:

① Opening Zapi menu.

② Press ENTER to go into the MAIN MENU.

③ The display will show: PARAMETER CHANGE.

④ Press ROLL UP or ROLL DOWN until TESTER menu appears on the display.

⑤ The display will show: TESTER.

⑥ Press ENTER to go into the TESTER function.

⑦ The first variable to be tested is shown on the display.

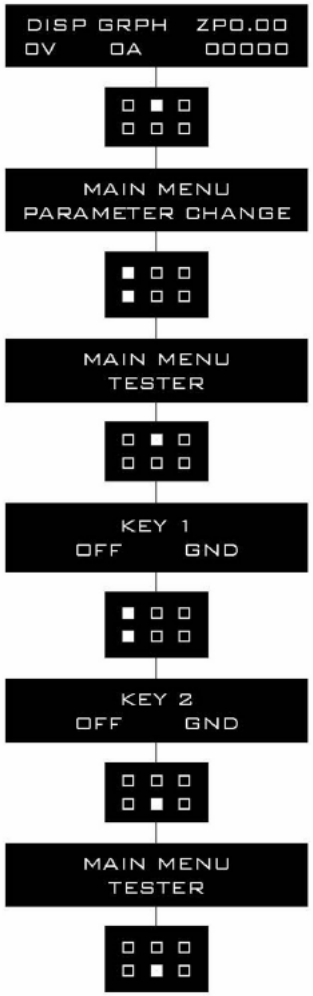
⑧ Press either ROLL UP or ROLL DOWN buttons.

⑨ Next variable for measurement appears.

⑩ When you have finished press OUT.

⑪ The Display will show: TESTER.

⑫ Press OUT again and return to opening Zapi menu.



Flow chart showing how to use the ALARMS function via the digital console:

① Opening Zapi menu.

② Press ENTER to go into the MAIN MENU.

③ The display will show:

④ Press ROLL UP or ROLL DOWN until ALARMS menu appears on the display.

⑤ The display will show:

⑥ Press ENTER to go into the ALARMS menu.

⑦ The display will show the most recent alarm.

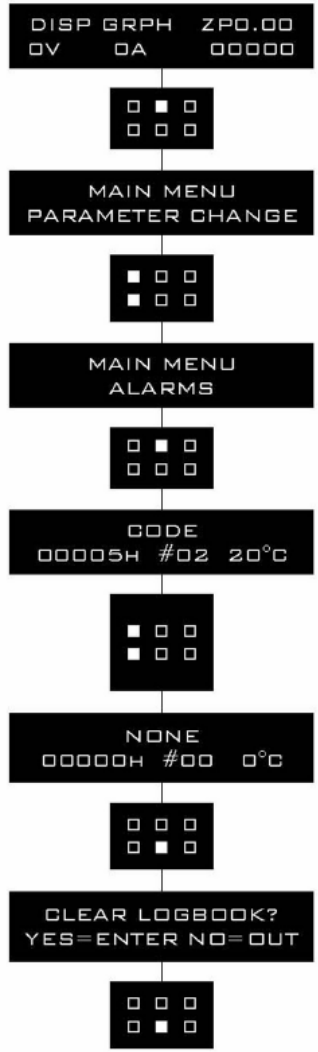
⑧ Each press of ROLL UP button brings up following alarms. Pressing ROLL DOWN returns to the most recent.

⑨ If an alarm has not occurred, the display will show: NONE.

⑩ When you have finished looking at the alarms, press OUT to exit the ALARMS menu.

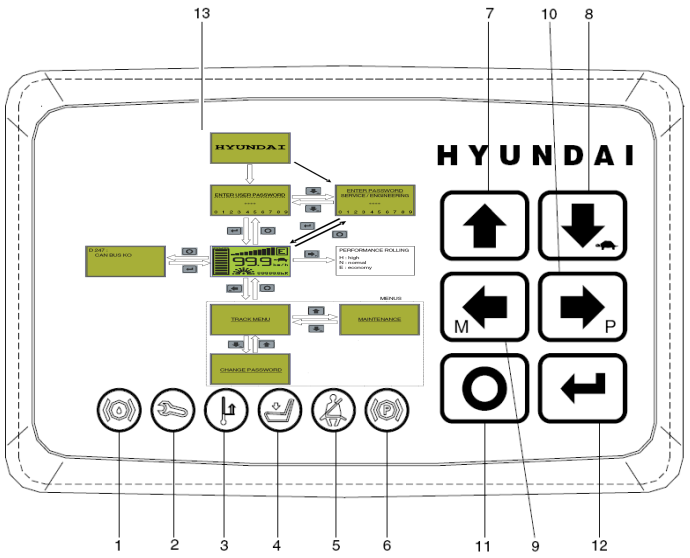
⑪ The display will ask: "CLEAR LOGBOOK?" Press ENTER for Yes, or OUT for No.

⑫ Press OUT again and return to opening Zapi menu.



Remember it is not possible to make any changes using TESTER.
All you can do is measure as if you were using a pre-connected multimeter.

- Enter the system through the machines display.



1 Oil level warning lamp (option)
2 Wrench warning lamp
3 Thermometer warning lamp
4 Seat warning lamp
5 Seat belt warning lamp (option)
6 Handbrake warning lamp
7 Key 1 button
8 Key 2 button
9 Key 3 button
10 Key 4 button
11 Key 5 button
12 Key 6 button
13 LCD function

- Button 1 (7) Performs function of the ROLL UP key
- Button 2 (8) Performs function of the ROLL DOWN key
- Button 3 (9) Performs function of the SET DOWN key
- Button 4 (10) Performs function of the SET UP key
- Button 5 (11) Performs function of the OUT key
- Button 6 (12)Performs function of the ENTER key

- Graphic Smart Display present a software structure made by menus and submenus. It is possible to have access to Graphic Smart Display menu structure by the six operator buttons integrated in a membrane keyboard. At turn on the display shows the HYUNDAI logo for some seconds, then asks the starting password, to have access to the main page (if "USER PASSWORD" option is ON), otherwise it shows directly the main page (if "USER PASSWORD" option is OFF).
- The main page, if there aren't alarms, shows battery charge, truck speed (in km/h or mph, it depends on "SPEED UNIT" parameter) and key/traction/pump hour meter (see "HOUR COUNTER" option); if alarms are present, it will show alarm code, node initials in which alarm has occurred and alarm description. From the main page it is possible to have access to the ALARM page (if alarms occur) and to MENUS page. The CHANGE PASSWORD MENU is always accessible and visible, while the others ones are accessible and showed, by entering service password. To enter this password its necessary to push the out button (button #5) of membrane keyboard; this will show a entering password page. By using service password it's possible to enter in all menus (TRUCK, CHANGE PASSWORD,MAINTENANCE). It follows flow chart diagram of menu structure.

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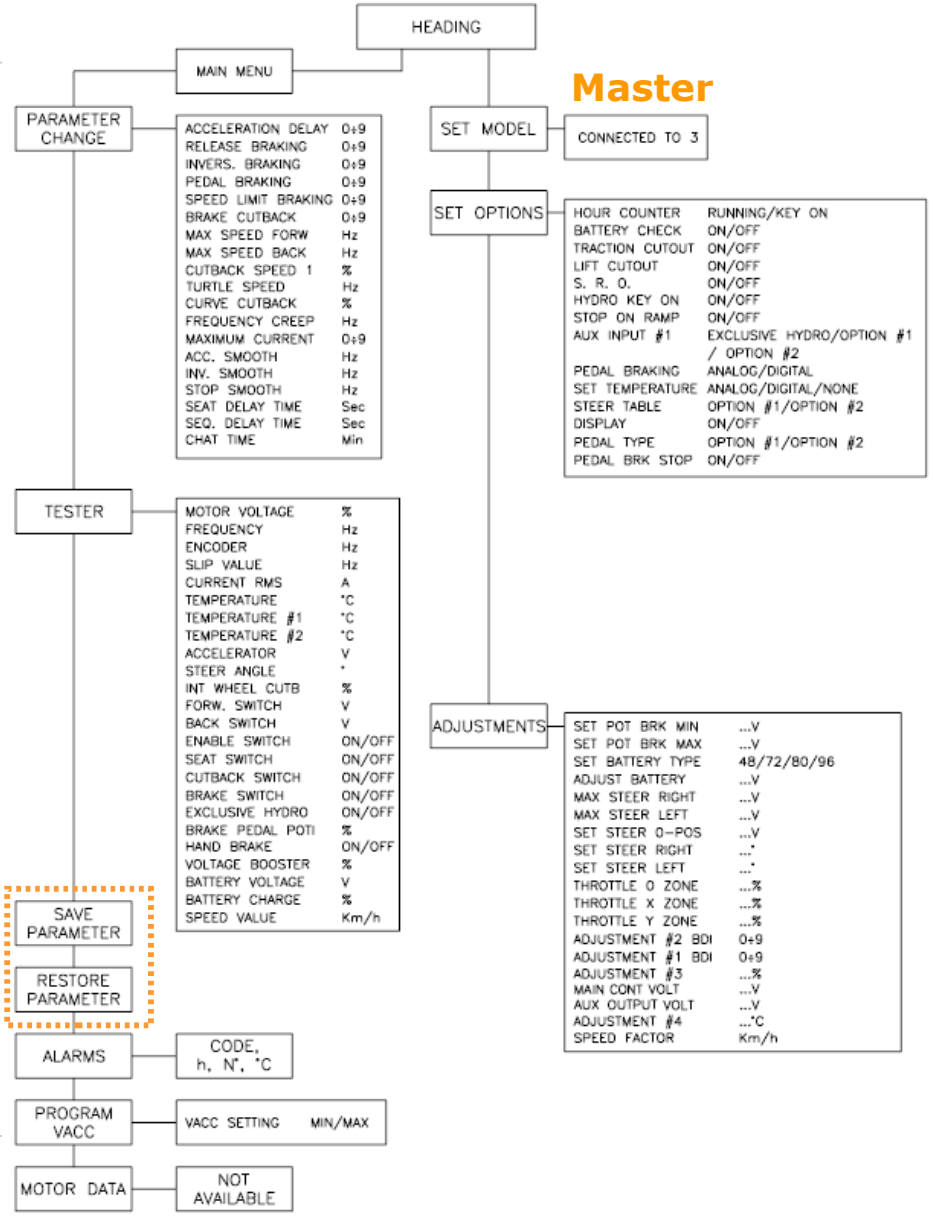
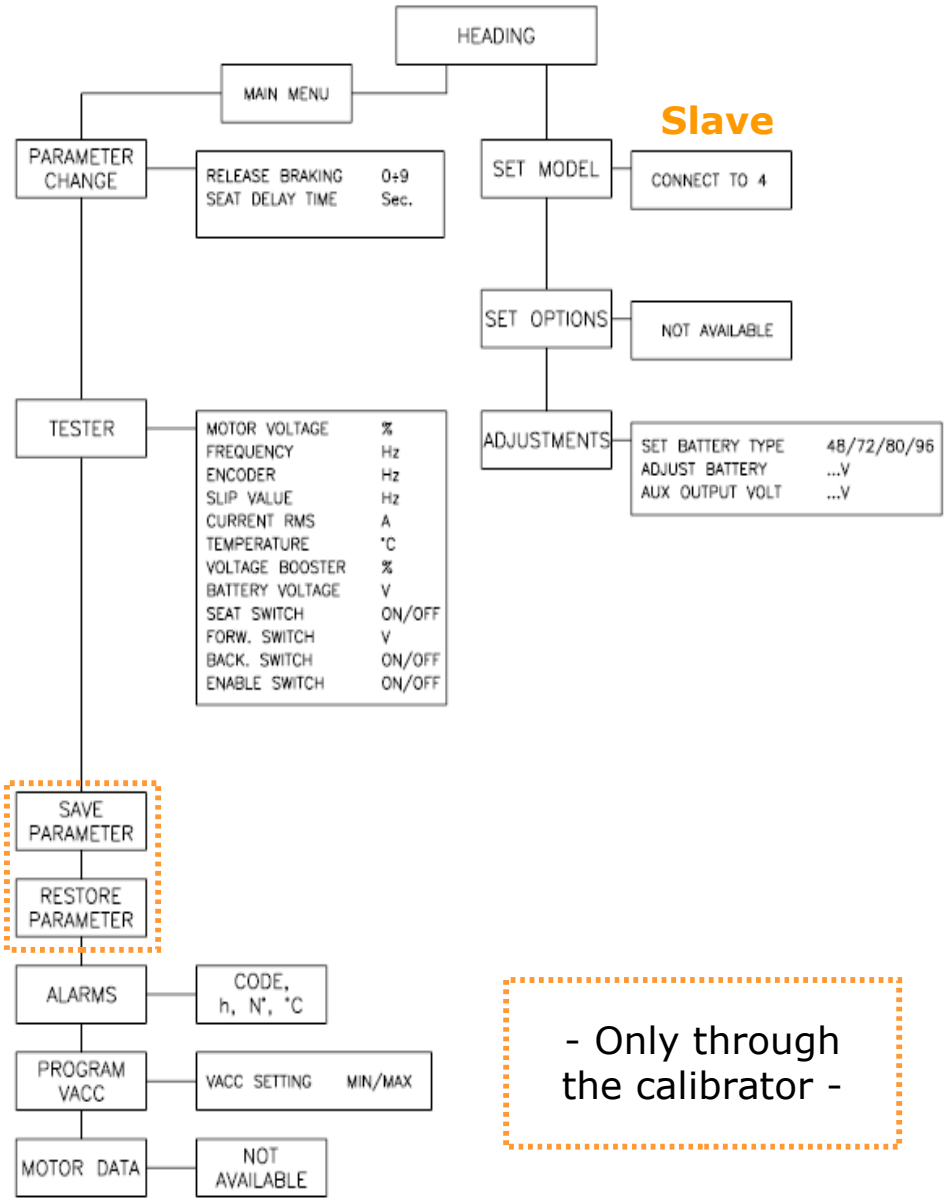
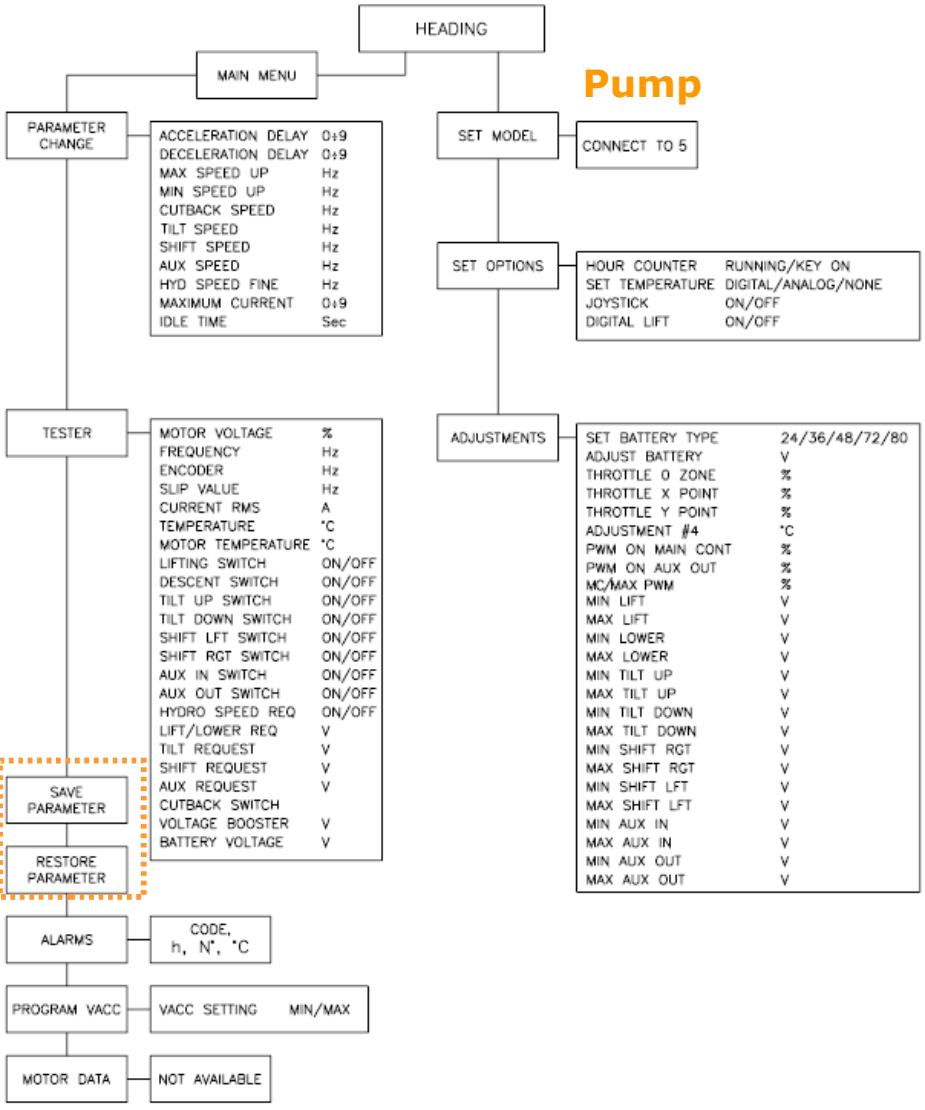
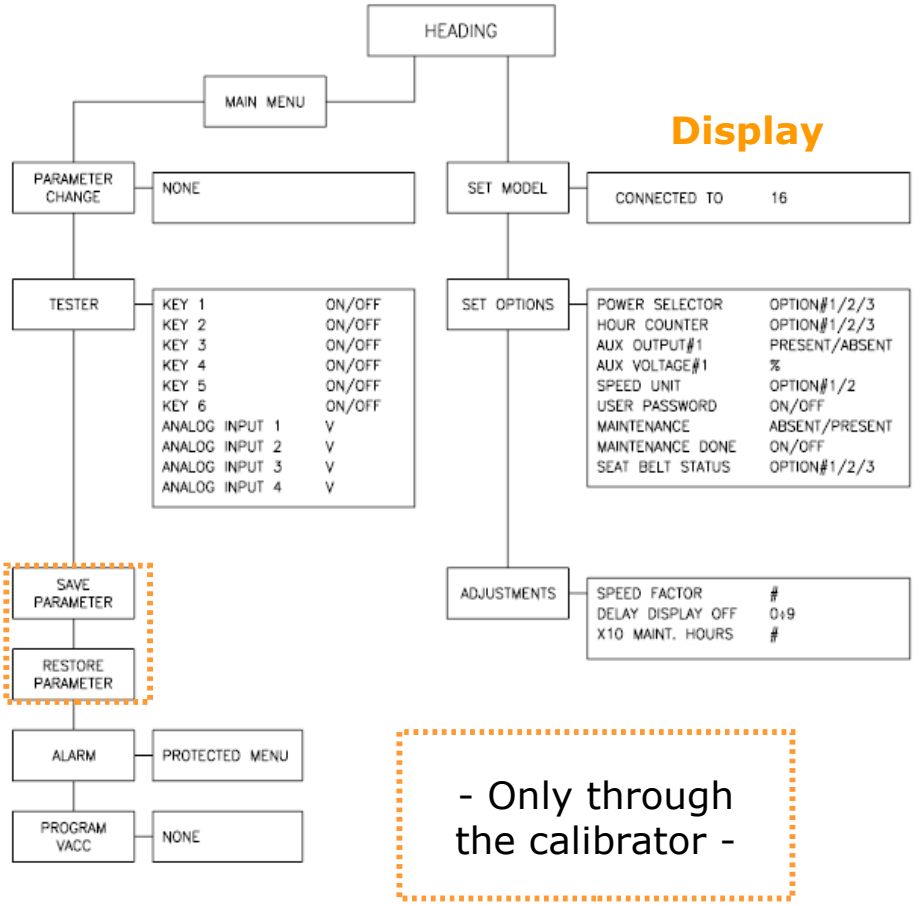
- Program menus: Traction master and Slave.





- Program menus: Pump and Display





- Only through the calibrator -

- Important adjustments -

Accelerator pedal adjustment:

1. Opening Zapi display.

2. Connect to the DUAL MASTER (03)

3. Press ENTER to go into the general menu.

4. Press ROLL UP or ROLL DOWN button until PROGRAM VACC. appear on the display.

5. Press ENTER to go into the PROGRAM VACC.

6. The display will show the minimum and maximum values of potentiometer wiper output.

7. Press ENTER to clear these values.

8. Select forward direction, close any interlock switches that may be in the system.

9. Slowly depress the accelerator pedal to its max. value.

10. The new minimum and maximum voltages will be displayed on the console an arrow indicating the direction, push OUT and YES.

11. Repeat from point 8 in reverse direction.

12. When finished, press OUT and ENTER to confirm.

Lift poti adjustment:

1. Opening Zapi display.

2. Connect to the AC2 or AC3 (05)

3. Press ENTER to go into the general menu.

4. Press ROLL UP or ROLL DOWN button until PROGRAM VACC. appear on the display.

5. Press ENTER to go into the PROGRAM VACC.

6. The display will show the minimum and maximum values of potentiometer wiper output.

7. Press ENTER to clear these values.

8. Slowly pull the “lift” lever completely back.

9. The new minimum and maximum voltages will be displayed on the console.

12. press OUT and ENTER (With the lever pulled) to confirm.

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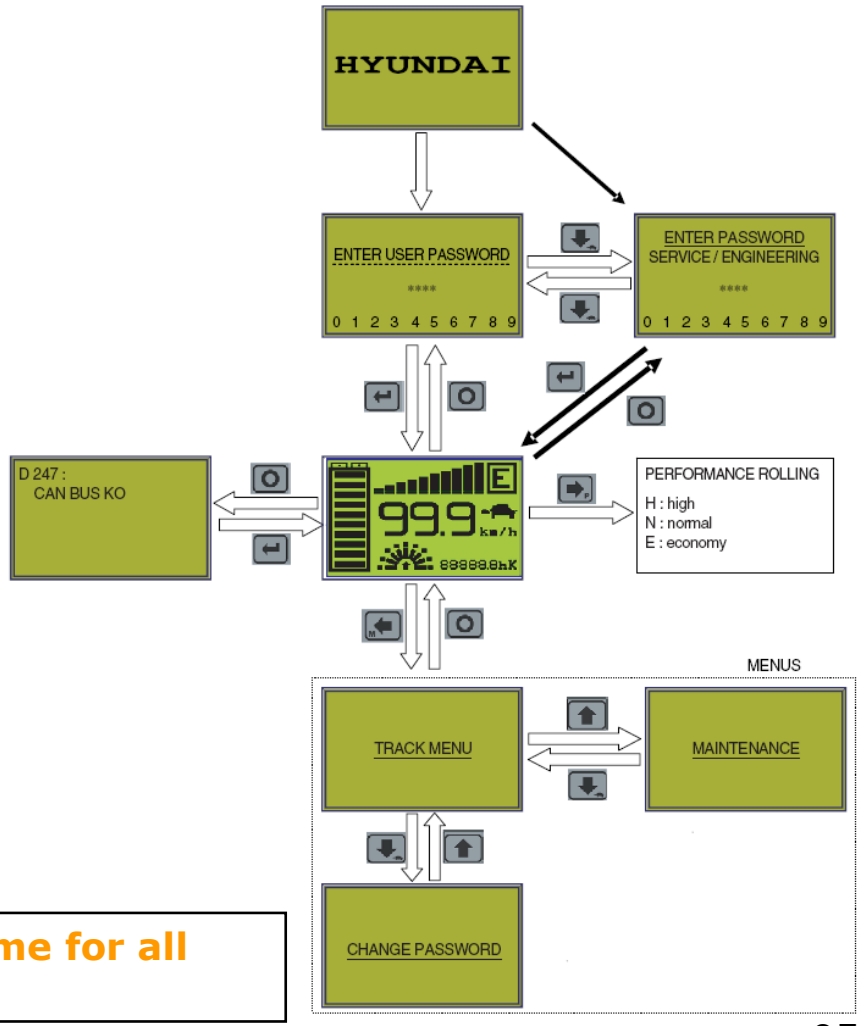
- Important adjustments -

Steering pot. teach-in :

1. Opening Zapi display.
2. Connect to the DUAL MASTER (03)
3. Press ROLL UP and SET UP to enter CONFIG MENU
4. Press ROLL UP or ROLL DOWN buttons until ADJUSTMENTS menu appears on the display.
5. Press ENTER to go into the ADJUSTMENTS menu.
6. Press ROLL UP or ROLL DOWN and select parameter "SET STEER RIGHT".
7. Press ENTER to clear these values.
8. Turn the steer wheel completely to the right.
9. The new value will appear on the display.
10. Press OUT and ENTER to save the new value.
11. Repeat from step 6 for SET STEER RIGHT and O-PO

Display and test parameters are the same for all models

Entering the system through the display:



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- Important adjustments, through display -

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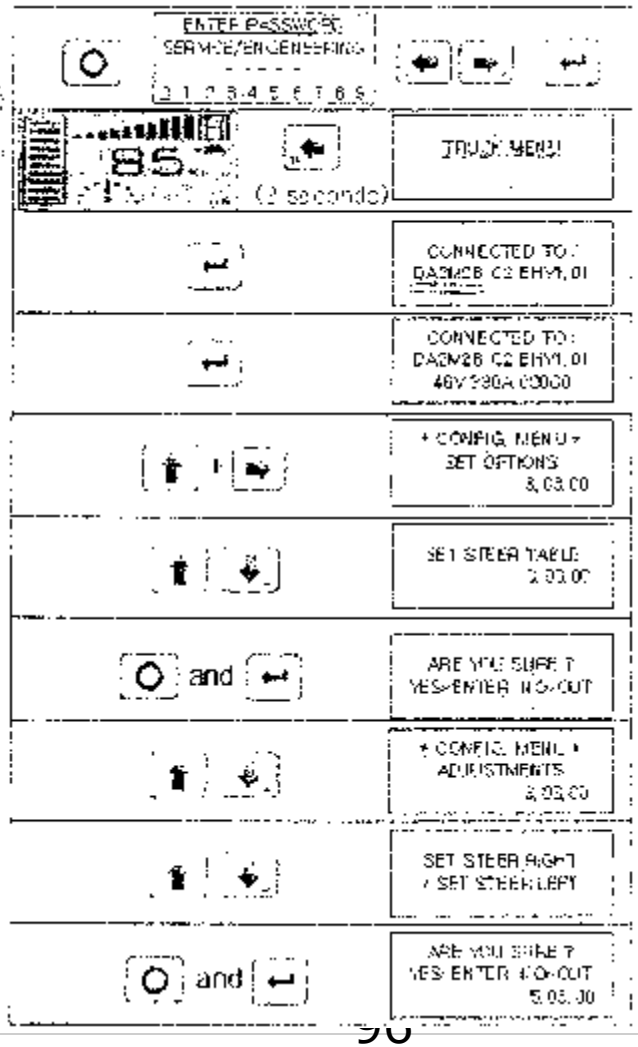
How to set and check parameters ?

1. How to set steering table?

1) Steer table (Master/set option)
This is used to set the correct steering table.
Option #1 : 3 wheel geometry
Option #2 : 4 wheel geometry

2) Set steer right(Master/adjustment)
This sets the max steering angle in right direction.
SET STEER RIGHT: 3W(90°) / 4W(97°)

3) Set steer left(Master/adjustment)
This sets the max steering angle in left direction.
SET STEER LEFT: 3W(90°) / 4W(75°)



- Important adjustments, through display -

2) How to set steering angle?

1) This function remembers the minimum and maximum voltage of the steering sensor

2) This should be set after replacing a new sensor or controller

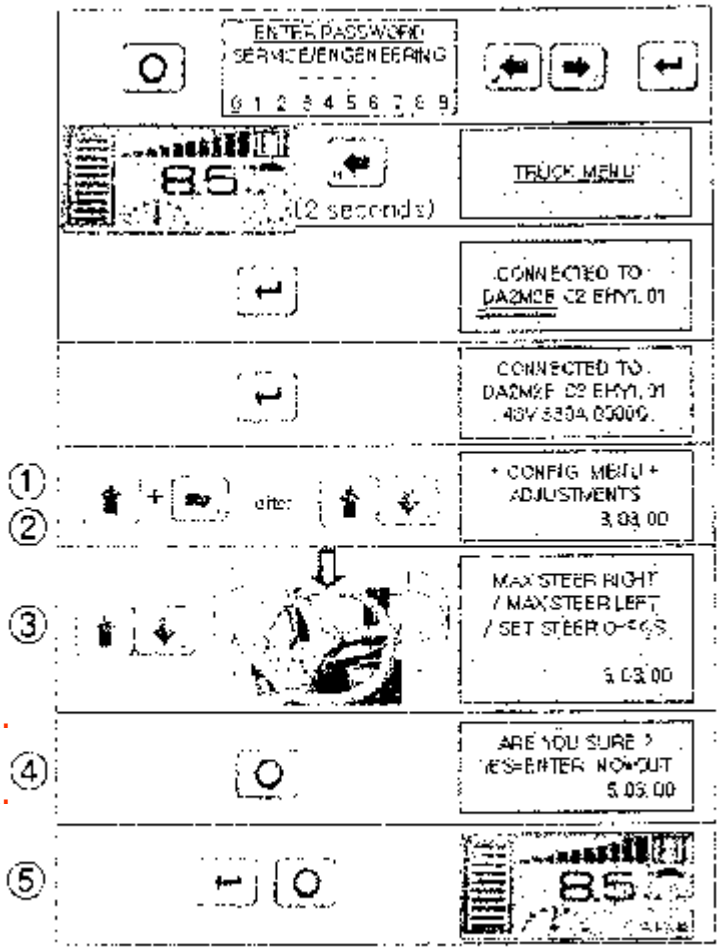
① Access : press two buttons together

② Select "Adjustment" submenu.

③ Select "max steer right". + ENTER.
Select forward direction and steer a handle to the maximum right. + OUT and YES + ENTER.
Select "max steer left" and steer a handle to the maximum left. + OUT and YES + ENTER.
Select "steer 0 pos" and steer the handle to 0 angle of steering wheel.

④ Press "out" button and you can see the question.

⑤ Press "enter" to save the value and press "out" to return the opening menu.



- Important adjustments, through display -

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3) How to set accelerator?

1) This function remembers the minimum and maximum voltage of accelerator.

2) This should be set after replacing a new accelerator or traction controller.

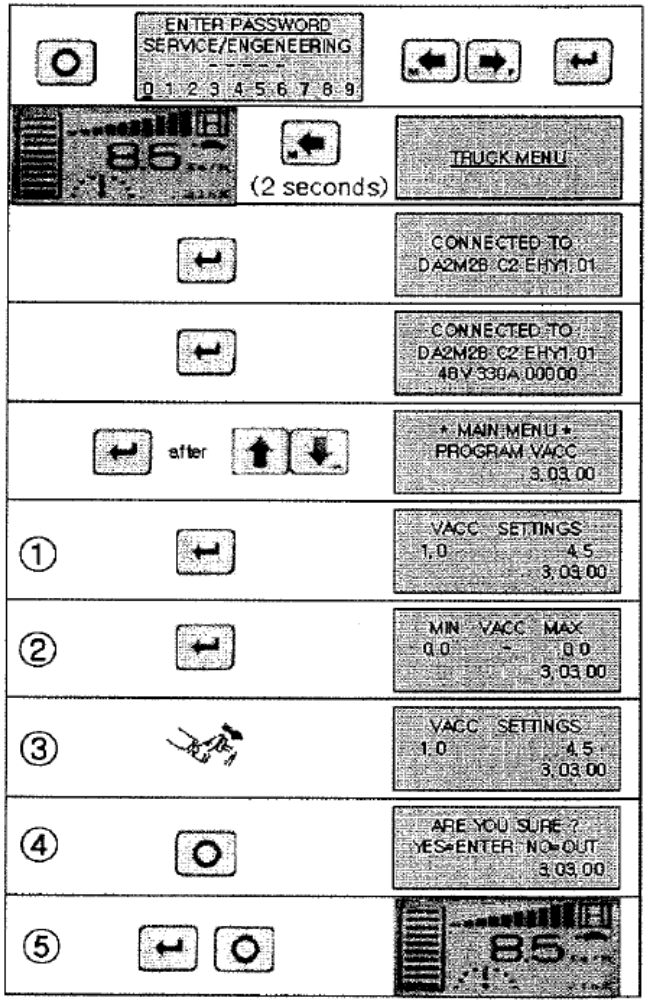
① The display shows present accel voltage

② when pressing the "enter" button, the voltage is changed to "0"

③ After selecting forward direction, Slowly depress the pedal to its maximum value. + OUT and Repeat from (3) and but select reverse direction.

④ Press "out" button with the pedal depressed and you can see the question.

⑤ Press "enter" to save the value and press "out" to return the opening menu.



- Important adjustments, through display -

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4) How to set lift sensor?

1) This function remembers the minimum and maximum voltage of lift sensor.

2) This should be set after replacing a new sensor or pump controller.

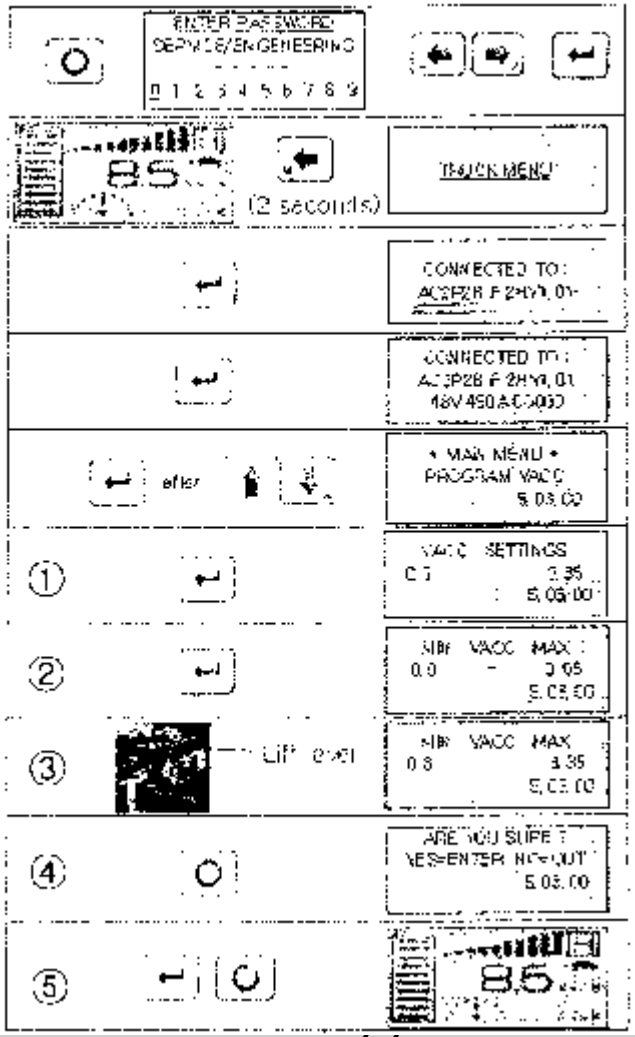
① The display shows present accel voltage

② when pressing the "enter" button, the voltage is changed to "0".

③ Slowly pull a lift lever to its maximum value.

④ Press "out" button with the lever pulled and you can see the question.

⑤ Press "enter" to save the value and press "out" to return the opening menu.



- Important adjustments, through display -

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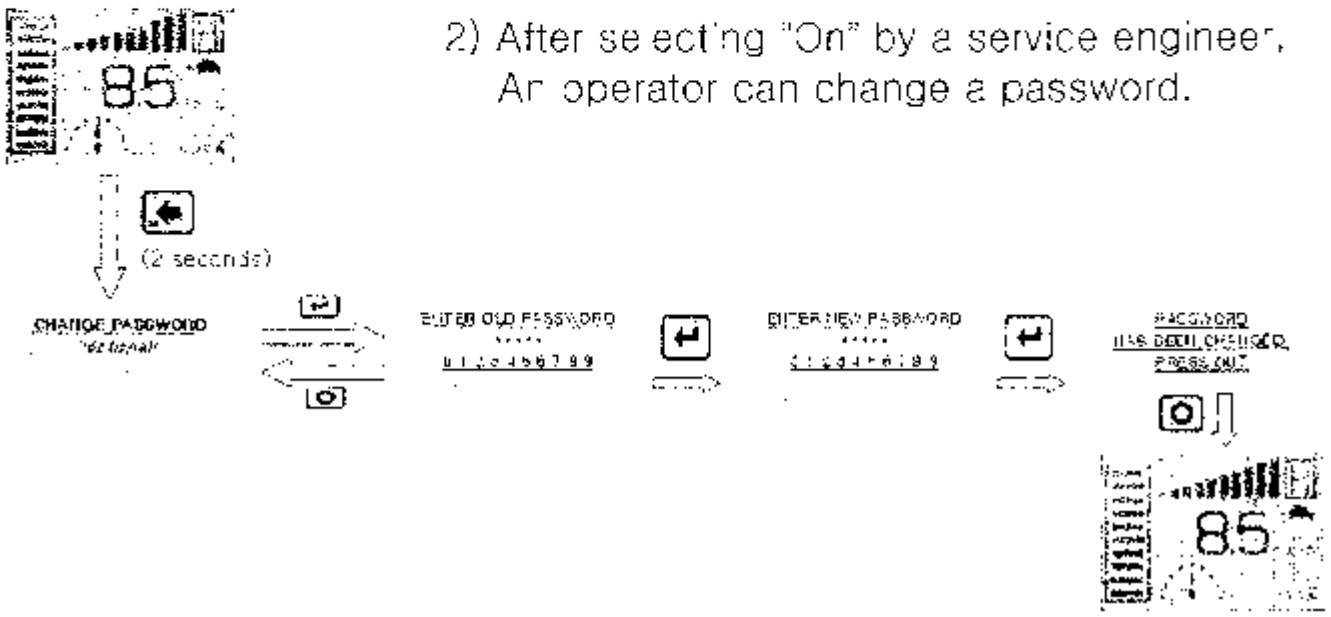
6) How to set a user password?

1) The parameter of "user password" should be selected from Off(default) to On(option) in order to apply password .
(Truck menu/Display/Parameter change/Set option(↑ + ↵)/User password)

2) After selecting "On" by a service engineer, An operator can change a password.



- 15/18/20BT-7, 16/18/20B-7 ZAPI Settings.

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HYUNDAI
HEAVY INDUSTRIES EUROPE

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- 15/18/20BT-7, 16/18/20B-7 Traction Master (03) setup.

Code	PARAMETER CHANGE / DESCRIPTION (Service level)	48V (Europe) E mode	48V (Europe) N mode	48V (Europe) H mode	Parameter explanation.
0	ACCELER. DELAY	LEVEL = 7	LEVEL = 6	LEVEL = 2	Determines the traction acceleration ramp-up. It's adjustable between 0 and 100Hz.
11	RELEASE BRAKING	LEVEL = 2	LEVEL = 3	LEVEL = 4	Deceleration ramp when accelerator pedal is released. Adjustable form 0 to 100Hz.
12	INVERS. BRAKING	LEVEL = 1	LEVEL = 3	LEVEL = 4	Brake force when direction switch is inverted during travel. Adjustable from 0 to 100 Hz
13	PEDAL BRAKING	LEVEL = 9			Brake force when travel request is released and brake pedal switch is closed. Adjustable from 100 to 0 Hz (Electrical brake support when mechanical brake is applied.
16	SPEED LIMIT BRK.	LEVEL = 4			Brake force when the accelerator pedal position is changed but not completely released.
28	BRAKE CUTBACK	LEVEL = 5			Deceleration ramp when the speed reduce input becomes active and the motor slow down.
30	MAX SPEED FORW	96	112	131	To set maximum speed in forward direction.
31	MAX SPEED BACK	96	112	131	To set maximum speed in backward direction.
21	CUTBACK SPEED 1	60%			% of max speed applied when the cutback switch is active. When set on 100% speed reduction is 0
253	TURTLE SPEED	70Hz			% of max speed applied when "turtle" speed is active. When set to 100% the speed reduction is 0
29	CURVE CUTBACK	30%			% Percentage of max speed applied when the steer is fully turned right/left. No speed reduction is applied when the steer angle is within the range [-8°;8°]. A linear reduction is applied in the middle.
245	FREQUENCY CREEP	0.30			Min. speed when the forward or reverse switch is closed, with accelerator in its min. position.
63	MAXIMUM CURRENT	LEVEL = 8			This changes the maximum current of the inverter.
241	ACC. SMOOTH	2.5	2.0	1.0	Difference form the acceleration curve in the frequency range 0 Hz to "Stop smooth" value (see Dual ac2 manual).
242	INV. SMOOTH	2.5	2.0	1.0	Different form to the acceleration curve after a direction inversion in the frequency range 0 Hz to "Stop smooth" value (see also Dual ac2 manual).
243	STOP SMOOTH	15	10	10	To sets the level of frequency where the smooth effect on the acceleration ramp ends.
248	SEAT DELAY TIME	2.0			It determines the traction deactivation delay when the seat switch is opened.
242	SEQUENCE DE.TIME	2			Max. Delay time between the accelerator is pressed and a direction is selected (SRO)
248	CHAT TIME	10			After the CHAT TIME has passed and no travel/pump request has been activated the main contactor is opened. Encoder signal is also monitored, To resume a travel/pump request is needed.

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- 15/18/20BT-7, 16/18/20B-7 Traction Master (03) setup.

Code	SET MODEL (service level)	Values	Parameter explanation.
	CONNECTED TO	3	Code 3 = Connected with Master controller (selection which controller you want to con.)
Code	**SET OPTIONS (Service level)**	**Values**	**Parameter explanation.**
125	HOUR COUNTER	KEY ON	RUNNING: the counter registers travel time only. KEY ON: the counter registers when the "key" switch is closed.
121	BATTERY CHECK	ON	ON: the battery discharge level check is carried out; when the battery level reaches 10% the traction maximum current is reduced to the half of the programmed value. Traction speed/current is also reduced (optional) and lift function is disabled(optional). At key on if battery is below 10% lift function is allowed for 10-20 seconds OFF: the battery discharge level check is carried out but no alarm is signalled.
245	TRACTION CUTOUT	ON OFF	ON : when the "Battery low" alarm appears, and this option is programmed "ON", the traction speed is reduced to 60 Hz.
244	LIFT CUTOUT	ON OFF	ON : When the "Battery low" alarm appears, and this option is programmed "ON" the lift function is disabled.
246	S. R. O.	ON	When S.R.O. option is set to "OFF" allowed sequences are: Key -> direction lever -> pedal Key-> pedal -> direction lever within the SEQUENCE DELAY TIME. No sequence is requested on the seat switch. When S.R.O. option is set to "ON" allowed sequences are: Key -> seat -> direction lever -> pedal seat -> key -> direction lever -> pedal Key-> seat -> pedal -> direction lever within the SEQUENCE DELAY TIME. seat -> Key-> pedal -> direction lever within the SEQUENCE DELAY TIME. The SEQUENCE DELAY TIME is adjustable. When pedal or direction levels are active at key on traction shows INCORRECT START. When incorrect sequence is detected traction shows SEQUENCE FAULT.
251	HYDRO KEY ON	OFF	ON : if this option is programmed "ON" the traction inverter manages an external hydraulic steering function when the "key" is switched ON.

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- 15/18/20BT-7, 16/18/20B-7 Traction Master (03) Setup.

Code	SET OPTIONS (Service level)	Values	Parameter explanation.
247	STOP ON RAMP	**OFF**	ON: the stop on ramp feature (truck electrically hold on a ramp) for 6 sec. OFF: the stop on ramp feature is not performed.
109	AUX INPUT #1	**OPTION #1**	EXCLUSIVE HYDRO: input C10 activates hydraulic steering function, output C31 is activated. OPTION #1: input C10 is the input for an handbrake device, active low (open switch). OPTION #2: input C10 is the input for a speed reduction device, active low (open switch)
251	PEDAL BRAKING	**DIGITAL**	ANALOG: the mechanical brake pedal has a switch and a potentiometer installed. When the accelerator is released and the pedal brake is pushed the inverter performs an electrical braking whose intensity is proportional to the brake pedal potentiometer. The minimum intensity is established by the "Release braking" parameter, when the brake pedal is slightly pressed (brake switch close but brake potentiometer at the minimum). The maximum intensity is established by the "Pedal braking" parameter when the brake pedal is fully pressed (brake potentiometer at the maximum). In the middle positions, the electrical braking intensity is a linear function between minimum and maximum intensity. DIGITAL: the truck does not have a potentiometer installed on the mechanical brake pedal, but only a microswitch; when the accelerator pedal is released and the brake pedal is pushed (brake switch closed), the inverter performs an electrical braking following "Pedal braking" parameter.
250	SET TEMPERATURE	**ANALOG**	DIGITAL: a digital (ON/OFF) motor thermal sensor is connected to C25 (C35) input. ANALOG: an analog motor thermal sensor is connected to C25 (C35) NONE: no motor thermal sensor switch is connected.
245	STEER TABLE	**PTION #1(3W) / OPTION #2(4V**	OPTION #1: The 3 wheels geometry is considered OPTION #2: The 4 wheels geometry is considered
247	DISPLAY	**ON**	if this option is programmed "ON" the communication with the Smart display is actived. If programmed to "OFF" the communication with the display is disabled and the modes can be changed by console using the MODE SELECT. Parameter.
85	PEDAL TYPE	**OPTION #1**	option #1: The pedal indication on the display shows the accelerator voltage level option #2: The pedal indication on the display shows the speed set-point level
28	PEDAL BRK STOP	**OFF**	If set to "on" the truck is stopped when the pedal brake is pressed. If set on "OFF" traction current will be reduced tohalf of the max. Current.

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- 15/18/20BT-7, 16/18/20B-7 Traction Master (03) Setup.

Code	ADJUSTMENTS (Service level)	Values	Parameter explanation.
245	SET POT BRK MIN	0.9 V	It records the minimum value of braking pedal potentiometer when the braking pedal switch is closed; the procedure is similar to the "Program Vacc" function (see chapter 9.3 of the manual). This procedure must be carried out only if the "Pedal braking" option is programmed as "Analog".
246	SET POT BRK MAX	9.0 V	It records the maximum value of braking pedal potentiometer when the braking pedal is fully pressed; the procedure is similar to the "Program Vacc" function (see chapter 9.3). This procedure must be carried out only if the "Pedal braking" option is programmed as "Analog".
145	SET BATTERY TYPE	48 V	Nominal battery voltage.
140	ADJUST BATTERY	51.40 V	Fine adjustment of the battery voltage measured by the controller (ZAPI production line adjusted).
249	MAX STEER RIGHT	4.4V	Steering poti output voltage when the wheels are fully turned right (maximum of the steering poti range).
243	MAX STEER LEFT	0.9V	Steering poti output voltage when the wheels are fully turned left (minimum of the steeringpoti range).
152	SET STEER 0-POS.	2.7V	Steering poti output voltage when the wheels are straight
246	SET STEER RIGHT	90 °(3W) / 97 °(4W)	This parameter sets the max steering angle in right direction.
241	SET STEER LEFT	90 °(3W) / 75 °(4W)	This parameter sets the max steering angle in left direction.
249	THROTTLE 0 ZONE	5%	Deadband in the accelerator input curve (see also curve in the dual ac2 manual).
252	THROTTLE X POINT	63%	This parameter changes the characteristic of the accelerator input curve.
253	THROTTLE Y POINT	25%	This parameter changes the characteristic of the accelerator input curve.
248	ADJUSTMENT#2 BDI	LEVEL = 3	It adjusts the lower level of the no-load battery discharge table. See also Dual ac2 manual
249	ADJUSTMENT#1 BDI	LEVEL = 3	It adjusts the upper level of the no-load battery discharge table. See also Dual ac2 manual
157	ADJUSTMENT#3	20%	At each key-off battery charge is stored. At each key on the battery voltage is read and the battery charge is estimated. The battery charge is updated only if the new estimated battery charge differs from the stored one by the ADJUSTMENT #3 set %.
251	MAIN CONT. VOLT.	36V	This parameters adjusts the Line contactor coil voltage (PWM output C26).
252	AUX OUTPUT VOLT.	36V	This parameters adjusts the Electric brake coil voltage (PWM output C28).
156	ADJUSTMENT#4	145 °	This parameter determines the motor temperature level at which the "Motor temperature" alarm is signalled. The range is from 0 °C to 200 °C with 1 °Csteps. This parameter must be adjusted only if the "Set temperature" (menu"Set option") parameter is programmed "Analog".
242	SPEED FACTOR	81	Speed Factor = (88 * rr * p) / Ø Where: rr = total gearbox reduction ratio, p = number of pair pole of the motor (2), Ø = traction wheel diameter expressed in centimeters (cm)

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- 15/18/20BT-7, 16/18/20B-7 Traction Master (03) Test .

Test parameters	Values expressed in	Parameter explanation.
Motor Voltage	**%**	Voltage supplied to the motor by the controller expressed in % of full battery voltage.
Frequency	**Hz**	Frequency of the voltage and current supplied to the motor.
Encoder	**Hz**	The speed of the motor in Hz. This information comes from the motor Encoders
Slip Value	**Hz**	Difference in speed between the rotating field and the motor shaft (rotator).
Current RMS	**A**	Root Mean Square value of the motor current. (RMS Power or the Root Mean Square of the Power is the average power in an AC circuit. It is like taking the average of the absolute value of the AC Power).RMS = (1/SQR2).(Peak)
Temperature	**°C**	Temperature of the aluminum heat sink, holding the MOSFETS. (Controller)
Motor Temperature	**°C**	Temperature of the motor itself. #1: RH and #2: LH
Accelerator	**V**	Voltage coming from accelerator pedal (LH side = Voltage / RH side = percentage).
Steer angle	**°**	This is the indication of the angular position of the steering wheel
Internal wheel cutback	**%**	Indication of speed reduction of the inner wheel during curving
Forw switch	**ON / OFF (V)**	Status of FW switch
Back switch	**ON / OFF (V)**	Status of REV switch
Enable switch	**ON / OFF**	Status of enable switch. This is the release switch inside accelerator pedal.
Seat switch	**ON / OFF**	Status of seat switch
Cutback switch	**ON / OFF**	Status of Speed Reduction Micro switch.
Brake switch	**ON / OFF**	Status of brake pedal micro switch
Exclusive hydro	**ON / OFF**	Status of exclusive hydro switch
Brake pedal poti	**%**	Value of poti on the brake pedal. (NOT FOR HYUNDAI).
Hand brake	**ON / OFF**	Status of hand brake switch
Voltage booster	%	This is the boost of the voltage supplied to the motor in load conditions
Battery voltage	V	Battery voltage measured at the key switch input.
Battery charge	%	Battery charge in %
Speed value	Km/h	Speed of the machine.

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- 15/18/20BT-7, 16/18/20B-7 Pump (05) Parameter setup.

CODE	PARAMETER CHANGE DESCRIPTION (Service level)	48V (Europe) E mode	N mode	H mode	Parameter explanation.
0	ACCELER. DELAY	LEVEL = 0			Determines the pump acceleration ramp-up. It's adjustable between 0 and 100Hz.
5	DECELER. DELAY	LEVEL = 0			Determines the pump deceleration ramp. It's adjustable between 0 and 100Hz.
246	MAX SPEED UP	81	92	108	Maximum pump speed during lift function.
245	MIN SPEED UP	18.00			Minimum pump speed during lift function after lifting enable switch is closed.
20	CUTBACK SPEED	100%			It determines max. lift speed when the speed reduction cutback switch is (open) E13.
242	TILT SPEED	30			Tilt function speed, fine regulation.
243	SHIFT SPEED	30			Shift function speed, fine regulation.
244	AUX SPEED	81			Auxiliary function speed, fine regulation.
48	HYD SPEED FINE	16			Hydro speed, fine regulation.**(Hydraulic Steering)**
63	MAXIMUM CURRENT	LEVEL = 9			The maximum current of the inverter.
56	IDLE TIME	1.9			Time delay when an hydraulic steering function request is switched off. (Steering del.)
CODE	**SET MODEL (Service level)**	**Values**			**Parameter explanation.**
	CONNECTED TO	5			Code 5 = Connected with pump controller (selection which controller you want to con.)
CODE	**SET OPTIONS (Service level)**	**Values**			**Parameter explanation.**
125	HOUR COUNTER	KEY ON			RUNNING: the counter registers travel time only. KEY ON: the counter registers when the "key" switch is closed.
141	SET TEMPERATURE	ANALOG			DIGITAL: a digital (ON/OFF) motor thermal sensor is connected to F6 input. ANALOG: an analog motor thermal sensor is connected between F6and F12 NONE: no motor thermal sensor switch is connected.
250	JOYSTICK	OFF			OFF: Truck with mechanical lever distributor. (std). ON: Truck with electro-hydraulic distributor. (Finger Tips)
249	DIGITAL LIFT	OFF			OFF: The lift speed is changed proportionally with the lift sensor analog input status. ON: The lift speed is determined only by the lift digital input. When the input is closed the pump run at full lift speed programmed.

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- 15/18/20BT-7, 16/18/20B-7 Pump (05) Parameter setup.

CODE	ADJUSTMENTS (service level)	Values	Parameter explanation.
145	**SET BATTERY TYPE**	**48 V**	To selects the nominal battery voltage.
140	**ADJUST BATTERY**	**51.7 V**	Fine adjustment of the battery voltage measured by the controller.
254	**THROTTLE 0 ZONE**	**5%**	It establishes a deadband in the accelerator input curve. See ac2 flash manual
252	**THROTTLE X POINT**	**63%**	Parameter changes the characteristic of the accelerator input curve. See ac2 manual
253	**THROTTLE Y POINT**	**36%**	Parameter changes the characteristic of the accelerator input curve. See ac2 manual
165	**ADJUSTMENT #04**	**145?**	This parameter determines the motor temperature level at which the "Motor temperature" alarm is signaled. The range is from 70°C to 160°C with 10°C steps. This parameter must be adjusted only if the "Set temperature" (menu"Set option") parameter is programmed "Analog".
253	**PWM ON MAIN CONT**	**OFF**	OFF: Battery voltage on main contactor coils. ON: Battery voltage reduced to 62%
254	**PWM ON AUX OUT.**	**OFF / ON (OPS)**	OFF: Battery voltage on aux output coils. ON: Battery voltage reduced to 62%
251	**MAX/AUX**	**60% / 25% (OPS)**	Aux out sensor maximum voltage recording. For the elctr-hyd distributor version it can be adjusted from console/display
252	**MIN LIFT**	**0.8V**	Lift sensor minimum voltage recording. For the lever version it can be adjusted using PROGRAM VACC function (see ac2 flash manual). For the elctr-hyd distributor version it can be adjusted from console/display (press enter).
251	**MAX LIFT**	**3.4V**	Lift sensor maximum voltage recording. For the lever version it can be adjusted using PROGRAM VACC function (see ac2 flash manual). For the elctr-hyd distributor version it can be adjusted from console/display (press enter).
250	**MIN LOWER**	**0.5V**	Lowering sensor minimum voltage recording.For the elctr-hyd distributor version it can be adjusted from console/display (press enter).
249	**MAX LOWER**	**4.6V**	Lowering sensor maximum voltage recording.For the elctr-hyd distributor version it can be adjusted from console/display (press enter).

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- 15/18/20BT-7, 16/18/20B-7 Pump (05) Parameter Setup.

CODE	ADJUSTMENTS (service level)	Values	Parameter explanation.
248	**MIN TILT UP**	**0.5V**	Tilt up sensor minimum voltage recording.For the elctr-hyd distributor version it can be adjusted from console/display (press enter).
247	**MAX TILT UP**	**4.5V**	Tilt up sensor maximum voltage recording.For the elctr-hyd distributor version it can be adjusted from console/display (press enter).
246	**MIN TILT DOWN**	**0.5V**	Tilt down sensor minimum voltage recording.For the elctr-hyd distributor version it can be adjusted from console/display (press enter).
245	**MAX TILT DOWN**	**4.5V**	Tilt down sensor maximum voltage recording.For the elctr-hyd distributor version it can be adjusted from console/display (press enter).
244	**MIN SHIFT RGT.**	**0.7V**	Shift right sensor minimum voltage recording.For the elctr-hyd distributor version it can be adjusted from console/display (press enter).
243	**MAX SHIFT RGT.**	**4.5V**	Shift right sensor maximum voltage recording.For the elctr-hyd distributor version it can be adjusted from console/display (press enter).
242	**MIN SHIFT LFT.**	**0.7V**	Shift left sensor minimum voltage recording.For the elctr-hyd distributor version it can be adjusted from console/display (press enter).
241	**MAX SHIFT LFT.**	**4.5V**	Shift left sensor maximum voltage recording.For the elctr-hyd distributor version it can be adjusted from console/display (press enter).
254	**MIN AUX IN**	**0.5V**	Aux in sensor minimum voltage recording.For the elctr-hyd distributor version it can be adjusted from console/display (press enter).
253	**MAX AUX IN**	**4.5V**	Aux in sensor maximum voltage recording.For the elctr-hyd distributor version it can be adjusted from console/display (press enter).
252	**MIN AUX OUT**	**0.5V**	Aux out sensor minimum voltage recording.For the elctr-hyd distributor version it can be adjusted from console/display (press enter).
251	**MAX AUX OUT**	**4.5V**	Aux out sensor maximum voltage recording.For the elctr-hyd distributor version it can be adjusted from console/display (press enter).

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- 15/18/20BT-7, 16/18/20B-7 Pump (05) Test.

Test parameters	Values expressed in	Parameter explanation.
Motor Voltage	**%**	Voltage supplied to the motor by the controller expressed in % of full battery voltage.
Frequency	**Hz**	Frequency of the voltage and current supplied to the motor.
Encoder	**Hz**	The speed of the motor in Hz. This information comes from the motor Encoders
Slip Value	**Hz**	Difference in speed between the rotating field and the motor shaft (rotator).
Current RMS	**A**	Root Mean Square value of the motor current. (RMS Power or the Root Mean Square of the Power is the average power in an AC circuit. It is like taking the average of the absolute value of the AC Power).RMS = (1/SQR2).(Peak)
Temperature	**°C**	Temperature of the aluminum heat sink, holding the MOSFETS. (Controller)
Motor Temperature	**°C**	Temperature of the motor itself. #1: RH and #2: LH
Accelerator	**V**	Voltage comming from accelerator pedal (LH side = Voltage / RH side = percentage).
Lifting Switch	**ON / OFF**	Status of lifting switch ON / OFF.
1st speed switch	**ON / OFF**	Status of first speed pump switch.
2de speed switch	**ON / OFF**	Status of 2de speed pump switch
3rd speed switch	**ON / OFF**	Status of 3rd speed pump switch.
4th speed switch	**ON / OFF**	Status of 4th speed pump switch.
Hydro speed req	**ON / OFF**	Status of hydro speed request.
Cutback switch	**ON / OFF**	Status of Speed Reduction Microswitch.
Voltage boost	**%**	The voltage boost supplied to the motor in load conditions expressed in % of full V.
Battery voltage	**V**	Battery voltage measured at the input to the key switch.
Battery charge	**%**	Battery charge in %.

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15/18/20BT-7, 16/18/20B-7 Pump (05)**(Fingertip option)**

- Pump settings -

PARAMETER CHANGE	E MODE	N MODE	H MODE
ACCELER. DELAY	LEVEL = 0		
DECELER. DELAY	LEVEL = 0		
MAX SPEED UP	81 Hz	92 Hz	108 Hz
MIN SPEED UP	18.00 Hz		
CUTBACK SPEED	100%		
TILT SPEED	30 Hz		
SHIFT SPEED	30 Hz		
AUX SPEED	81 Hz		
HYD SPEED FINE	16 Hz		
MAXIMUM CURRENT	LEVEL = 9		
IDLE TIME	1,5		
SET OPTION			
HOUR COUNTER	KEYON		
SET TEMPERATURE	ANALOG		
JOYSTICK	ON		
SHIFT FUNCTION	OFF / 4 valves ON		
AUX FUNCTION	OFF / 3 valves ON		
DIGITAL LIFT	OFF		
SET MODEL			
CONNECTED TO	PUMP		
ADJUSTMENTS			
SET BATTERY TYPE	48V		
ADJUST BATTERY	49.2 V		
THROTTLE 0 ZONE	5%		
THROTTLE X POINT	63%		
THROTTLE Y POINT	36%		
ADJUSTMENT #04	145 ?		
PWM ON MAIN CONT	OFF		
PWM ON AUX OUT.	ON		
MC/AUX PWM	25%		
MIN LIFT	2.4 V		
MAX LIFT	0.5 V		
MIN LOWER	2.4 V		
MAX LOWER	4.4 V		
MIN TILT UP	2.4 V		
MAX TILT UP	0.5 V		
MIN TILT DOWN	2.4 V		
MAX TILT DOWN	4.4 V		
MIN SHIFT RGT.	2.4 V		
MAX SHIFT RGT.	0.5 V		
MIN SHIFT LFT.	2.4 V		
MAX SHIFT LFT.	4.4 V		
MIN AUX IN	2,4 V		
MAX AUX IN	4.5 V		
MIN AUX OUT	2.4 V		
MAX AUX OUT	0.5 V		

- Mhyrio settings -

PARAMETER CHANGE	
MIN EVP	25,10%
MAX EVP	85,10%
MIN EVP1	25,10%
MAX EVP1	70,20%
MIN EVP2	25,10%
MAX EVP2	85,10%
MIN EVP3	25,10%
MAX EVP3	85,10%
MIN EVP4	25,10%
MAX EVP4	85,10%
MIN EVP5	25,10%
MAX EVP5	85,10%
MIN EVP6	25,10%
MAX EVP6	85,10%
MIN EVP7	25,10%
MAX EVP7	85,10%
MIN EVP8	25,10%
MAX EVP8	85,10%
EVP OPEN DELAY	0,2
EVP CLOSE DELAY	0,4
EVP1 OPEN DELAY	0,2
EVP1 CLOSE DELAY	0,1
EVP2 OPEN DELAY	0,2
EVP2 CLOSE DELAY	0,1
EVP3 OPEN DELAY	0,2
EVP3 CLOSE DELAY	0,4
EVP4 OPEN DELAY	0,2
EVP4 CLOSE DELAY	0,4
EVP5 OPEN DELAY	0,8
EVP5 CLOSE DELAY	0,4
EVP6 OPEN DELAY	0,8
EVP6 CLOSE DELAY	0,4
EVP7 OPEN DELAY	0,2
EVP7 CLOSE DELAY	0,4
EVP8 OPEN DELAY	0,2
EVP8 CLOSE DELAY	0,4
SET OPTION	
SET BATTERY TYPE	48V
V VALVES COIL	24V
VALVES SUPPLY	48V
EVP TYPE	ANALOG
EVP1 TYPE	ANALOG
EVP2 TYPE	ANALOG
EVP3 TYPE	ANALOG
EVP4 TYPE	ANALOG
EVP5 TYPE	ANALOG
EVP6 TYPE	ANALOG
EVP7 TYPE	ANALOG
EVP8 TYPE	ANALOG
SET MODEL	
CONNECT TO	MHYRIO
ADJUSTMENTS	
ADJUST BATTERY	49.2 V

15/18/20BT-7, 16/18/20B-7 Display (16) Parameter setup.

Parameters	Values expressed in	Parameter explanation.
Power selector	**H / N / E**	Trucks performances. Option 1:H / Option 2:N / Option 3:E
Hour counter	**Option #1**	Hours displayed on the display: Option 1: key / Option 2: traction / Option 3: pump
Aux output #1	**Absent**	Present: Load between PAUX and NAUX / Absent : no load between PAUX and NAUX
Aux voltage	**100**	% of battery power supplied to AUX coil to close the Auxiliary electro valve.
Speed unit	**Option #1**	option #2 = speed in mph
User password	**OFF**	ON = after key-on a user password is asked to utilize the Graphic Smart Display.
Maintenance	**Absent**	Present: A maintenance hour counter is incremented with key ON. When the selected hours are reached, the message "SERVICE REQUIRED" appears.
Maintenance done	**OFF**	If "ON" at next key-on maintenance hours are updated with display hours and deletes the "MAINTENANCE NEEDED" warning
Seat Belt Status	**Option #2**	Option #1: No "seat belt" diagnostic. Option #2: Seat belt not fastened = 3 flashes / Option #3: Seat belt has to be fastened, if not LED on display on.

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- 22/25/30/32B-7 Zapi settings.

113

- 22/25/30/32B-7 Traction Master (03) setup -

Code	PARAMETER CHANGE	E MODE	N MODE	H MODE
0	ACCELER.DELAY	LEVEL = 7	LEVEL = 6	LEVEL = 2
11	RELEASE BRAKING	LEVEL = 2	LEVEL = 3	LEVEL = 4
12	INVERS.BRAKING	LEVEL = 1	LEVEL = 3	LEVEL = 4
13	PEDAL BRAKING	LEVEL = 9	LEVEL = 9	LEVEL = 9
16	SPEED LIMIT BRK.	LEVEL = 4	LEVEL = 4	LEVEL = 4
28	BRAKE CUTBACK	LEVEL = 5	LEVEL = 5	LEVEL = 5
30	MAX SPEED FORW	115 Hz	138 Hz	160 Hz
31	MAX SPEED BACK	115 Hz	138 Hz	160 Hz
21	CUTBACK SPEED 1	60%	60%	60%
253	TURTLE SPEED	88 Hz	88 Hz	88 Hz
29	CURVE CUTBACK	30%	30%	30%
245	FREQUENCY CREEP	0.30 Hz	0.30 Hz	0.30 Hz
63	MAXIMUM CURRENT	LEVEL = 6	LEVEL = 6	LEVEL = 6
241	ACC.SMOOTH	2,5	2	1
242	INV.SMOOTH	2,5	2	1
243	STOP SMOOTH	15 Hz	10 Hz	10 Hz
248	SEAT DELAY TIME	2	2	2
242	SEQUENCE DE.TIME	2	2	2
248	CHAT TIME	10	10	10

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- 22/25/30/32B-7 Traction Master (03) setup -

Code	SET OPTION	E MODE	N MODE	H MODE
125	HOUR COUNTER	KEYON	KEYON	KEYON
121	BATTERY CHECK	ON	ON	ON
245	TRACTION CUTOUT	ON	ON	ON
244	LIFT CUTOUT	ON	ON	ON
246	S.R.O.	ON	ON	ON
251	HYDRO KEY ON	OFF	OFF	OFF
247	STOP ON RAMP	OFF	OFF	OFF
109	AUX INPUT #1	OPTION #1	OPTION #1	OPTION #1
251	PEDAL BRAKING	DIGITAL	DIGITAL	DIGITAL
250	SET TEMPERATURE	ANALOG	ANALOG	ANALOG
245	STEER TABLE	OPTION #4	OPTION #4	OPTION #4
247	DISPLAY	ON	ON	ON
85	PEDAL TYPE	OPTION #1	OPTION #1	OPTION #1
247	PEDAL BRK STOP	OFF	OFF	OFF
Code	**SET MODEL**	**E MODE**	**N MODE**	**H MODE**
250	CONNECTED TO	3	3	3

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- 22/25/30/32B-7 Traction Master (03) setup -

Code	ADJUSTMENTS	E MODE	N MODE	H MODE
245	SET POT BRK MIN	1.0 V	1.0 V	1.0 V
246	SET POT BRK MAX	9.0 V	9.0 V	9.0 V
145	SET BATTERY TYPE	48V	48V	48V
140	ADJUST BATTERY	50.92 V	50.59 V	50.78 V
249	MAX STEER RIGHT	1.2 V	1.2 V	1.2 V
243	MAX STEER LEFT	3.9 V	3.9 V	3.9 V
152	SET STEER 0-POS.	2.8 V	2.8 V	2.8 V
246	SET STEER RIGHT			
241	SET STEER LEFT			
249	THROTTLE 0 ZONE	5%	5%	5%
252	THROTTLE X POINT	63%	63%	63%
253	THROTTLE Y POINT	25%	25%	25%
248	ADJUSTMENT#2 BDI	LEVEL = 5	LEVEL = 5	LEVEL = 5
249	ADJUSTMENT#1 BDI	LEVEL = 6	LEVEL = 6	LEVEL = 6
157	ADJUSTMENT #03	20%	20%	20%
251	MAIN CONT.VOLT.	36 V	36 V	36 V
252	AUX OUTPUT VOLT.	12 V	12 V	12 V
156	ADJUSTMENT #04			
242	SPEED FACTOR	87	87	87

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- 22/25/30/32B-7 Traction Slave (04) setup -

Code	PARAMETER CHANGE	E MODE	N MODE	H MODE
11	RELEASE BRAKING	LEVEL = 2	LEVEL = 3	LEVEL = 4
248	SEAT DELAY TIME	2	2	2
Code	**SET MODEL**			
250	CONNECTED TO	4	4	4
Code	**ADJUSTMENTS**			
145	SET BATTERY TYPE	48V	48V	48V
140	ADJUST BATTERY	50.59 V	50.59 V	50.83 V
242	AUX OUTPUT VOLT.	12 V	12 V	12 V

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- 22/25/30/32B-7 Pump (05) setup -

Code	PARAMETER CHANGE	E MODE	N MODE	H MODE
0	ACCELER. DELAY	LEVEL = 0	LEVEL = 0	LEVEL = 0
5	DECELER. DELAY	LEVEL = 0	LEVEL = 0	LEVEL = 0
246	MAX SPEED UP	72 Hz	81 Hz	90 Hz
245	MIN SPEED UP	16.50 Hz	16.50 Hz	16.50 Hz
20	CUTBACK SPEED	100%	100%	100%
242	TILT SPEED	50 Hz	50 Hz	50 Hz
243	SHIFT SPEED	30 Hz	30 Hz	30 Hz
244	AUX SPEED	81 Hz	81 Hz	81 Hz
48	HYD SPEED FINE	16 Hz	16 Hz	16 Hz ← Hydraulic Steering.
63	MAXIMUM CURRENT	LEVEL = 8	LEVEL = 8	LEVEL = 8
245	IDLE TIME	1,5	1,5	1,5
Code	**SET OPTION**	**E MODE**	**N MODE**	**H MODE**
125	HOUR COUNTER	KEYON	KEYON	KEYON
141	SET TEMPERATURE	ANALOG	ANALOG	ANALOG
249	DIGITAL LIFT	OFF	OFF	OFF

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- 22/25/30/32B-7 Pump (05) setup -

Code	SET MODEL	E MODE	N MODE	H MODE
242	CONNECTED TO	PUMP	PUMP	PUMP
Code	**ADJUSTMENTS**	**E MODE**	**N MODE**	**H MODE**
145	SET BATTERY TYPE	48V	48V	48V
140	ADJUST BATTERY	50.6 V	50.6 V	50.6 V
254	THROTTLE 0 ZONE	5%	5%	5%
252	THROTTLE X POINT	63%	63%	63%
253	THROTTLE Y POINT	36%	36%	36%
156	ADJUSTMENT #04	145	145	145
253	PWM ON MAIN CONT	ON	ON	ON
254	PWM ON AUX OUT.	OFF	OFF	OFF
248	MC/AUX PWM	75%	75%	75%

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- 22/25/30BHA-7 Zapi settings.

- 22/25/30BHA-7 Traction Master (03) setup -

PARAMETER CHANGE	E MODE	N MODE	H MODE
ACCELER. DELAY	LEVEL = 6	LEVEL = 6	LEVEL = 1
RELEASE BRAKING	LEVEL = 2	LEVEL = 2	LEVEL = 4
INVERS. BRAKING	LEVEL = 1	LEVEL = 1	LEVEL = 4
PEDAL BRAKING	LEVEL = 9	LEVEL = 9	LEVEL = 9
SPEED LIMIT BRK.	LEVEL = 4	LEVEL = 4	LEVEL = 4
BRAKE CUTBACK	LEVEL = 5	LEVEL = 5	LEVEL = 5
MAX SPEED FORW	109 Hz	134 Hz	158 Hz
MAX SPEED BACK	109 Hz	134 Hz	158 Hz
CUTBACK SPEED 1	60%	60%	60%
TURTLE SPEED	70 Hz	70 Hz	70 Hz
CURVE CUTBACK	30%	30%	30%
FREQUENCY CREEP	0.30 Hz	0.30 Hz	0.30 Hz
MAXIMUM CURRENT	LEVEL = 8	LEVEL = 8	LEVEL = 8
ACC. SMOOTH	2,5	2,5	1
INV. SMOOTH	2,5	2,5	1
STOP SMOOTH	15 Hz	15 Hz	10 Hz
SEAT DELAY TIME	2	2	2
SEQUENCE DE.TIME	2	2	2
CHAT TIME	10	10	10

- 22/25/30BHA-7 Traction Master (03) setup -

SET OPTION			
HOUR COUNTER	KEYON	KEYON	KEYON
BATTERY CHECK	ON	ON	ON
TRACTION CUTOUT	ON	ON	ON
LIFT CUTOUT	ON	ON	ON
S.R.O.	ON	ON	ON
HYDRO KEY ON	OFF	OFF	OFF
STOP ON RAMP	OFF	OFF	OFF
AUX INPUT #1	OPTION #1	OPTION #1	OPTION #1
PEDAL BRAKING	DIGITAL	DIGITAL	DIGITAL
SET TEMPERATURE	ANALOG	ANALOG	ANALOG
STEER TABLE	OPTION #3	OPTION #3	OPTION #3
DISPLAY	ON	ON	ON
PEDAL TYPE	OPTION #1	OPTION #1	OPTION #1
PEDAL BRK STOP	OFF	OFF	OFF
SET MODEL			
CONNECTED TO	3	3	3

- 22/25/30BHA-7 Traction Master (03) setup -

ADJUSTMENTS			
SET POT BRK MIN	1.0 V	1.0 V	1.0 V
SET POT BRK MAX	9.0 V	9.0 V	9.0 V
SET BATTERY TYPE	80V	80V	80V
ADJUST BATTERY	82.32 V	82.08 V	82.00 V
MAX STEER RIGHT	1.2 V	1.2 V	1.2 V
MAX STEER LEFT	4.0 V	4.0 V	4.0 V
SET STEER 0-POS.	2.9 V	2.9 V	2.9 V
SET STEER RIGHT	90 °	90 °	90 °
SET STEER LEFT	65 °	65 °	65 °
THROTTLE 0 ZONE	5%	5%	5%
THROTTLE X POINT	63%	63%	63%
THROTTLE Y POINT	25%	25%	25%
ADJUSTMENT#2 BDI	LEVEL = 2	LEVEL = 2	LEVEL = 2
ADJUSTMENT#1 BDI	LEVEL = 3	LEVEL = 3	LEVEL = 3
ADJUSTMENT #03	20%	20%	20%
MAIN CONT. VOLT.	36 V	36 V	36 V
AUX OUTPUT VOLT.	36 V	36 V	36 V
ADJUSTMENT #04	145 ℃	145 ℃	145 ℃
SPEED FACTOR	83	83	83

- 22/25/30BHA-7 Traction Slave (04) setup -

PARAMETER CHANGE	E MODE	N MODE	H MODE
RELEASE BRAKING	LEVEL = 2	LEVEL = 2	LEVEL = 4
SEAT DELAY TIME	2	2	2
SET MODEL			
CONNECTED TO	4	4	4
ADJUSTMENTS			
SET BATTERY TYPE	80V	80V	80V
ADJUST BATTERY	82.08 V	82.08 V	81.68 V
AUX OUTPUT VOLT.	12 V	12 V	12 V

- 22/25/30BHA-7 Pump (05) setup -

PARAMETER CHANGE	E MODE	N MODE	H MODE
ACCELER. DELAY	LEVEL = 0	LEVEL = 0	LEVEL = 0
DECELER. DELAY	LEVEL = 0	LEVEL = 0	LEVEL = 0
MAX SPEED UP	74 Hz	84 Hz	93 Hz
MIN SPEED UP	18.00 Hz	18.00 Hz	18.00 Hz
CUTBACK SPEED	100%	100%	100%
TILT SPEED	30 Hz	30 Hz	30 Hz
SHIFT SPEED	30 Hz	30 Hz	30 Hz
AUX SPEED	81 Hz	81 Hz	81 Hz
HYD SPEED FINE	30 Hz	30 Hz	30 Hz
MAXIMUM CURRENT	LEVEL = 9	LEVEL = 9	LEVEL = 9
IDLE TIME	1,5	1,5	1,5
SET OPTION			
HOUR COUNTER	KEYON	KEYON	KEYON
SET TEMPERATURE	ANALOG	ANALOG	ANALOG
JOYSTICK	OFF	OFF	OFF
DIGITAL LIFT	OFF	OFF	OFF
SET MODEL			
CONNECTED TO	PUMP	PUMP	PUMP
ADJUSTMENTS			
SET BATTERY TYPE	80V	80V	80V
ADJUST BATTERY	82.5 V	82.1 V	82.5 V
THROTTLE 0 ZONE	5%	5%	5%
THROTTLE X POINT	63%	63%	63%
THROTTLE Y POINT	36%	36%	36%
ADJUSTMENT #04	145 ℃	145 ℃	145 ℃
PWM ON MAIN CONT	OFF	OFF	OFF
PWM ON AUX OUT.	ON	ON	ON
MC/AUX PWM	15%	15%	15%

- 22/25/30BHA-7 Pump (05) **(Fingertip option)**

- Pump settings -

PARAMETER CHANGE	E MODE	N MODE	H MODE
ACCELER. DELAY	LEVEL = 0		
DECELER. DELAY	LEVEL = 0		
MAX SPEED UP	74 Hz	84 Hz	93 Hz
MIN SPEED UP	18.00 Hz		
CUTBACK SPEED	100%		
TILT SPEED	30 Hz		
SHIFT SPEED	30 Hz		
AUX SPEED	81 Hz		
HYD SPEED FINE	30 Hz		
MAXIMUM CURRENT	LEVEL = 9		
IDLE TIME	1,5		
SET OPTION			
HOUR COUNTER	KEYON		
SET TEMPERATURE	ANALOG		
JOYSTICK	ON		
SHIFT FUNCTION	OFF / 4 valves ON		
AUX FUNCTION	OFF / 3 valves ON		
DIGITAL LIFT	OFF		
SET MODEL			
CONNECTED TO	PUMP		
ADJUSTMENTS			
SET BATTERY TYPE	80V		
ADJUST BATTERY	82.1 V		
THROTTLE 0 ZONE	5%		
THROTTLE X POINT	63%		
THROTTLE Y POINT	36%		
ADJUSTMENT #04	145 ?		
PWM ON MAIN CONT	OFF		
PWM ON AUX OUT.	ON		
MC/AUX PWM	15%		
MIN LIFT	2.4 V		
MAX LIFT	0.5 V		
MIN LOWER	2.4 V		
MAX LOWER	4.4 V		
MIN TILT UP	2.4 V		
MAX TILT UP	0.5 V		
MIN TILT DOWN	2.4 V		
MAX TILT DOWN	4.4 V		
MIN SHIFT RGT.	2.4 V		
MAX SHIFT RGT.	0.5 V		
MIN SHIFT LFT.	2.4 V		
MAX SHIFT LFT.	4.4 V		
MIN AUX IN	2,4 V		
MAX AUX IN	4.5 V		
MIN AUX OUT	2.4 V		
MAX AUX OUT	0.5 V		

- Mhyrio settings -

PARAMETER CHANGE	
MIN EVP	25,10%
MAX EVP	85,10%
MIN EVP1	25,10%
MAX EVP1	70,20%
MIN EVP2	25,10%
MAX EVP2	85,10%
MIN EVP3	25,10%
MAX EVP3	85,10%
MIN EVP4	25,10%
MAX EVP4	85,10%
MIN EVP5	25,10%
MAX EVP5	85,10%
MIN EVP6	25,10%
MAX EVP6	85,10%
MIN EVP7	25,10%
MAX EVP7	85,10%
MIN EVP8	25,10%
MAX EVP8	85,10%
EVP OPEN DELAY	0,2
EVP CLOSE DELAY	0,4
EVP1 OPEN DELAY	0,2
EVP1 CLOSE DELAY	0,1
EVP2 OPEN DELAY	0,2
EVP2 CLOSE DELAY	0,1
EVP3 OPEN DELAY	0,2
EVP3 CLOSE DELAY	0,4
EVP4 OPEN DELAY	0,2
EVP4 CLOSE DELAY	0,4
EVP5 OPEN DELAY	0,8
EVP5 CLOSE DELAY	0,4
EVP6 OPEN DELAY	0,8
EVP6 CLOSE DELAY	0,4
EVP7 OPEN DELAY	0,2
EVP7 CLOSE DELAY	0,4
EVP8 OPEN DELAY	0,2
EVP8 CLOSE DELAY	0,4
SET OPTION	
SET BATTERY TYPE	80V
V VALVES COIL	24V
VALVES SUPPLY	80V
EVP TYPE	ANALOG
EVP1 TYPE	ANALOG
EVP2 TYPE	ANALOG
EVP3 TYPE	ANALOG
EVP4 TYPE	ANALOG
EVP5 TYPE	ANALOG
EVP6 TYPE	ANALOG
EVP7 TYPE	ANALOG
EVP8 TYPE	ANALOG
SET MODEL	
CONNECT TO	MHYRIO
ADJUSTMENTS	
ADJUST BATTERY	82.8 V

- 22/25/30BHA-7 Display (16) settings.

SET OPTION	E MODE	N MODE	H MODE
POWER SELECTOR	OPTION #3	OPTION #2	OPTION #1
HOUR COUNTER	OPTION #1	OPTION #1	OPTION #1
AUX OUTPUT #1	ABSENT	ABSENT	ABSENT
AUX VOLTAGE #1	100%	100%	100%
SPEED UNIT	OPTION #1	OPTION #1	OPTION #1
USER PASSWORD	OFF	OFF	OFF
MAINTENANCE	PRESENT	PRESENT	PRESENT
MAINTENANCE DONE	OFF	OFF	OFF
SEATBELT STATUS	OPTION #2	OPTION #2	OPTION #2
STEER ANGLE	ON	ON	ON
SET MODEL			
CONNECTED TO	DISPLAY	DISPLAY	DISPLAY
ADJUSTMENTS			
DELAY DISP. OFF	LEVEL = 0	LEVEL = 0	LEVEL = 0

- 35/40/45/50B-7 Zapi settings.

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- 35/40/45/50B-7 Traction Master (03) setup -

Code	PARAMETER CHANGE	E MODE	N MODE	H MODE
0	ACCELER. DELAY	LEVEL = 3	LEVEL = 2	LEVEL = 1
11	RELEASE BRAKING	LEVEL = 2	LEVEL = 2	LEVEL = 1
12	INVERS. BRAKING	LEVEL = 3	LEVEL = 5	LEVEL = 6
13	PEDAL BRAKING	LEVEL = 7	LEVEL = 7	LEVEL = 7
16	SPEED LIMIT BRK.	LEVEL = 6	LEVEL = 6	LEVEL = 6
28	BRAKE CUTBACK	LEVEL = 5	LEVEL = 5	LEVEL = 5
30	MAX SPEED FORW	98 Hz	125 Hz	145 Hz
31	MAX SPEED BACK	98 Hz	125 Hz	145 Hz
20	CUTBACK SPEED	100%	100%	100%
251	TURTLE SPEED	76 Hz	76 Hz	76 Hz
29	CURVE CUTBACK	30%	30%	30%
245	FREQUENCY CREEP	0.30 Hz	0.30 Hz	0.30 Hz
63	MAXIMUM CURRENT	LEVEL = 4	LEVEL = 4	LEVEL = 4
241	ACC. SMOOTH	2	2	1,5
242	INV. SMOOTH	2	2	1,5
243	STOP SMOOTH	15 Hz	10 Hz	10 Hz
241	SEAT DELAY TIME	2	2	2
242	SEQUENCE DE.TIME	2	2	2
248	CHAT TIME	10	10	10

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- 35/40/45/50B-7 Traction Master (03) setup -

Code	SET OPTION	E MODE	N MODE	H MODE
125	HOUR COUNTER	KEYON	KEYON	KEYON
121	BATTERY CHECK	ON	ON	ON
246	TRACTION CUTOUT	ON	ON	ON
245	LIFT CUTOUT	ON	ON	ON
251	HYDRO KEY ON	OFF	OFF	OFF
247	STOP ON RAMP	OFF	OFF	OFF
109	AUX INPUT #1	OPTION #2	OPTION #2	OPTION #2
13	PEDAL BRAKING	DIGITAL	DIGITAL	DIGITAL
141	SET TEMPERATURE	ANALOG	ANALOG	ANALOG
245	STEER TABLE	OPTION #3	OPTION #3	OPTION #3
247	DISPLAY	ON	ON	ON
243	S.R.O.	ON	ON	ON
85	PEDAL TYPE	OPTION #1	OPTION #1	OPTION #1
244	PEDAL BRK STOP	OFF	OFF	OFF
119	AUX OUTPUT #1	BRAKE	BRAKE	BRAKE
Code	**SET MODEL**	**E MODE**	**N MODE**	**H MODE**
250	CONNECTED TO	3	3	3

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- 35/40/45/50B-7 Traction Master (03) setup -

Code	ADJUSTMENTS	E MODE	N MODE	H MODE
245	SET POT BRK MIN	0.5 V	0.5 V	0.5 V
246	SET POT BRK MAX	4.5 V	4.5 V	4.5 V
145	SET BATTERY TYPE	80V	80V	80V
140	ADJUST BATTERY	83.9 V	83.9 V	83.9 V
249	MAX STEER RIGHT	0.7 V	0.7 V	0.7 V
243	MAX STEER LEFT	3.1 V	3.1 V	3.1 V
152	SET STEER 0-POS.	2.1 V	2.1 V	2.1 V
246	SET STEER RIGHT	85	85	85
241	SET STEER LEFT	63	63	63
249	THROTTLE 0 ZONE	0%	0%	0%
252	THROTTLE X POINT	63%	63%	63%
253	THROTTLE Y POINT	25%	25%	25%
248	ADJUSTMENT#2 BDI	LEVEL = 3	LEVEL = 3	LEVEL = 3
249	ADJUSTMENT#1 BDI	LEVEL = 3	LEVEL = 3	LEVEL = 3
157	ADJUSTMENT #03	20%	20%	20%
62	AUX TIME #1	5	5	5
251	PWM ON MAIN CONT	ON	ON	ON
252	PWM ON AUX OUT.	OFF	OFF	OFF
156	ADJUSTMENT #04	145	145	145
247	SPEED FACTOR	75	75	75

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- 35/40/45/50B-7 Traction Slave (04) setup -

CODE	PARAMETER CHANGE	E MODE	N MODE	H MODE
63	MAXIMUM CURRENT	LEVEL = 4	LEVEL = 4	LEVEL = 4
Code	**SET OPTION**			
125	HOUR COUNTER	KEYON	KEYON	KEYON
119	AUX OUTPUT #1	BRAKE	BRAKE	BRAKE
141	SET TEMPERATURE	ANALOG	ANALOG	ANALOG
Code	**SET MODEL**			
250	CONNECTED TO	4	4	4
Code	**ADJUSTMENTS**			
145	SET BATTERY TYPE	80V	80V	80V
140	ADJUST BATTERY	82.5 V	82.5 V	82.5 V
247	PWM ON AUX OUT.2	12V	12V	12V
248	PWM ON AUX OUT.	OFF	OFF	OFF

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- 35/40/45/50B-7 Pump (05) setup -

Code	PARAMETER CHANGE	E MODE	N MODE	H MODE
0	ACCELER. DELAY	LEVEL = 0	LEVEL = 0	LEVEL = 0
5	DECELER. DELAY	LEVEL = 0	LEVEL = 0	LEVEL = 0
242	MAX SPEED UP	85 Hz	92 Hz	100 Hz
248	MIN SPEED UP	18.00 Hz	18.00 Hz	18.00 Hz
20	CUTBACK SPEED	100%	100%	100%
252	TILT SPEED	40 Hz	40 Hz	40 Hz
253	SHIFT SPEED	35 Hz	35 Hz	35 Hz
254	AUX SPEED	40 Hz	40 Hz	40 Hz
48	HYD SPEED FINE	18 Hz	18 Hz	18 Hz
63	MAXIMUM CURRENT	LEVEL = 9	LEVEL = 9	LEVEL = 9
246	IDLE TIME	1,5	1,5	1,5
Code	**SET OPTION**	**E MODE**	**N MODE**	**H MODE**
125	HOUR COUNTER	KEYON	KEYON	KEYON
141	SET TEMPERATURE	ANALOG	ANALOG	ANALOG
247	DISPLAY	ON	ON	ON
249	DIGITAL LIFT	OFF	OFF	OFF

Hydraulic Steering.

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- 35/40/45/50B-7 Pump (05) setup -

Code	SET MODEL	E MODE	N MODE	H MODE
250	CONNECTED TO	5	5	5
Code	**ADJUSTMENTS**	**E MODE**	**N MODE**	**H MODE**
145	SET BATTERY TYPE	80V	80V	80V
140	ADJUST BATTERY	83.4 V	83.4 V	83.4 V
249	THROTTLE 0 ZONE	9%	9%	9%
252	THROTTLE X POINT	72%	72%	72%
253	THROTTLE Y POINT	15%	15%	15%
251	PWM ON MAIN CONT	ON	ON	ON
252	PWM ON AUX OUT.	OFF	OFF	OFF
156	ADJUSTMENT #04	145	145	145

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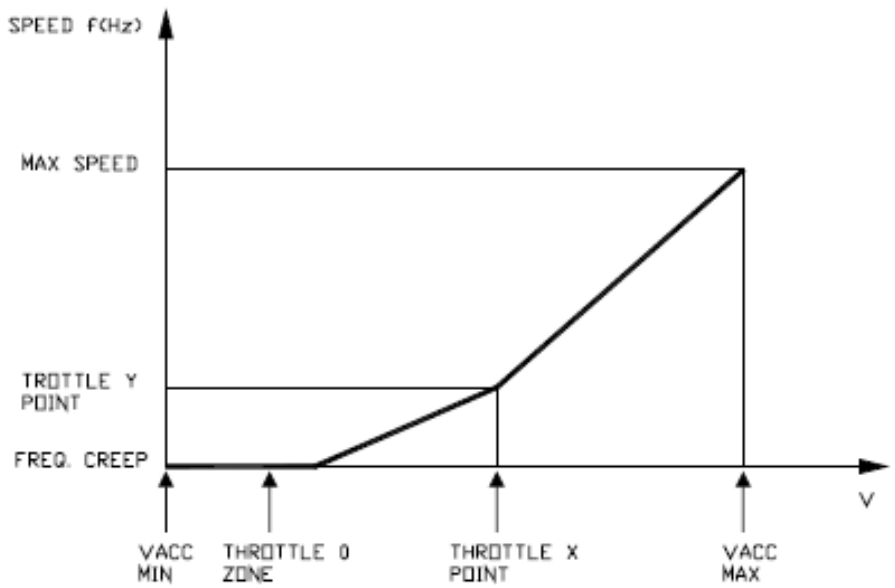
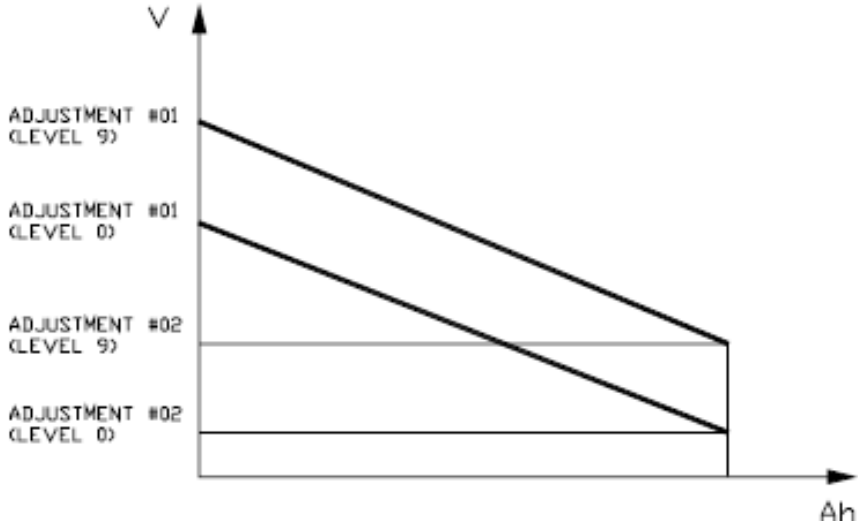
- Parameter setting variables -

- Acceleration potentiometer setup -



THROTTLE 0 ZONE
It establishes a dead band in the accelerator input curve.
THROTTLE X POINT
This parameter changes the characteristic of the accelerator input curve.
THROTTLE Y POINT
This parameter changes the characteristic of the accelerator input curve.

- Battery discharge setup -



ADJUSTMENT#1 BDI
It adjusts the upper level of the battery discharge table.
ADJUSTMENT#2 BDI
It adjusts the lower level of the battery discharge table.

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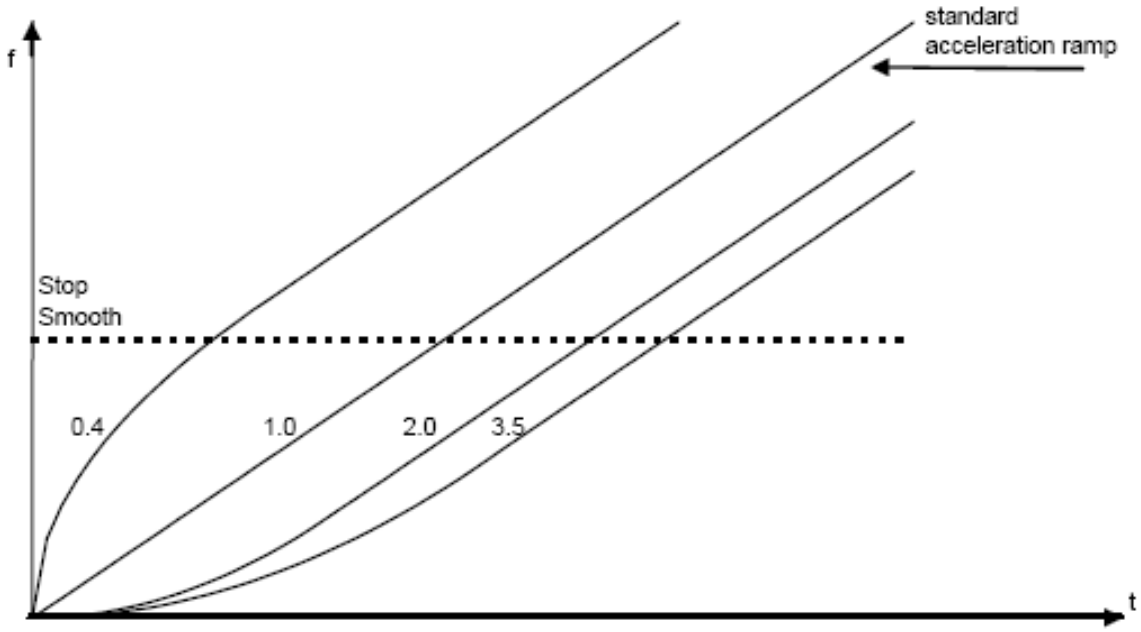
- Parameter setting variables -

- Smooth parameters setup -



0.4, 1.0, 2.0, 3.5 are some possible values of the "Acc. Smooth" and "Inv. Smooth" parameters (see the table below).

ACC. SMOOTH
It gives a different form to the acceleration curve in the frequency range 0 Hz
to "Stop smooth" value (see the figure below).

INV. SMOOTH
It gives a different form to the acceleration curve after a direction inversion in
the frequency range 0 Hz to "Stop smooth" value (see the figure below).

STOP SMOOTH
It sets the level of frequency where the smooth effect on the acceleration ramp ends.

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- Parameter setting variables -

The following table shows the different values at which the parameters can be set.

PARAMETER	UNIT	PROGRAMMED LEVEL									
		0	1	2	3	4	5	6	7	8	9
ACCELERATION DELAY (*)	Sec.	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0	5.5
RELEASE BRAKING (**)	Sec.	5.5	5.0	4.5	4.0	3.5	3.0	2.5	2.0	1.5	1.0
INVERSION BRAKING (**)	Sec.	5.5	5.0	4.5	4.0	3.5	3.0	2.5	2.0	1.5	1.0
PEDAL BRAKING (**)	Sec.	4.0	3.5	3.0	2.5	2.0	1.5	1.2	1.0	0.7	0.5
SPEED LIMIT BRAKING (**)	Sec.	8.9	8.3	7.7	7.1	6.6	6.0	5.5	4.9	4.4	3.8
BRAKE CUTBACK (**)	Sec.	5.5	5.0	4.5	4.0	3.5	3.0	2.5	2.0	1.5	1.0
MAX SPEED FW	Hz	65	80	95	110	125	140	155	170	185	200
MAX SPEED BW	Hz	65	80	95	110	125	140	155	170	185	200
CUTBACK SPEED 1	%	10	20	30	40	50	60	70	80	90	100
CURVE CUTBACK	%	10	15	20	25	38	50	63	75	87	100
FREQUENCY CREEP	Hz	0.3	0.6	0.9	1.2	1.5	1.8	2.1	2.4	2.7	3.0
MAXIMUM CURRENT	%IMAX	47	53	59	65	70	76	82	88	94	100
BACKING SPEED	Hz	0	2	4	6	8	10	12	14	16	18
BACKING TIME	Sec.	0.3	1.1	1.9	2.8	3.7	4.5	5.4	6.3	7.1	8.0
ACC. SMOOTH		1.0	1.2	1.5	1.7	2.0	2.2	2.5	2.7	3.0	3.5
INV. SMOOTH		0.4	0.6	0.8	1.0	1.2	1.5	1.7	2.0	2.5	3.0
STOP SMOOTH	Hz	5	7	10	12	15	17	20	22	25	27
AUXILIARY TIME	Sec.	0	0.2	0.4	0.8	1	1.5	2	3	4	5

(*) The acceleration time shown is the time from 0 Hz to 100 Hz. This is the ideal ramp calculated by the software; the real ramp could change as a function of motor control parameter setting and, obviously, as a function of the load.

(**) The braking feature is based upon deceleration ramps. The value shown in the table is the time to decrease the speed from 100 Hz to 0 Hz. This is the ideal ramps calculated by the software; the real ramp could change as a function of motor control parameter setting and, obviously, as a function of the load.

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- Failure codes -

Code	Alarm string	Master	Slave	Pump	Description	Condition that has to occur to come out from alarm status
8	WATCHDOG	X	X	X	Alarm : The Watchdog circuit has been triggered.	· If the alarm is present in Init status, remove the alarm condition · If the alarm has occurred in standby or running mode, it is necessary to remove alarm condition and to activate a traction request
17	LOGIC FAILURE #3	X	X	X	Alarm: Failure in over-load protection hw circuit	To remove alarm condition + activation of traction request
18	LOGIC FAILURE #2	X	X	X	Alarm: Failure in U, V, W voltage feedback circuit	To remove alarm condition + activation of traction request
19	LOGIC FAILURE #1	X	X	X	Alarm: An overvoltage or undervolt. Condition has been detected.	To recycle the key switch
30	VMN LOW	X	X	X	Alarm: Wrong voltage on motor power out-puts; Failure in the power section or in the mosfet driver circuit or in the motor	· If the alarm is present in Init status, remove the alarm condition · If the alarm has occurred in standby or running mode, it is necessary to remove alarm condition and to activate a traction request
31	VMN HIGH	X	X	X	Alarm: Wrong voltage on motor power outputs; Failure in the power section or in the mosfet driver circuit or in the motor	· If the alarm is present in Init status, remove the alarm condition · If the alarm has occurred in standby or running mode, it is necessary to remove alarm condition and to activate a traction request
53	standby I HIGH	X	X	X	Alarm: Wrong voltage in the current sensor feedback circuit	· If the alarm is present in Init status, remove the alarm condition · If the alarm has occurred in standby or running mode, it is necessary to remove alarm condition and to activate a traction request
60	CAP CHARGE	X	X	X	Alarm: Power capaci-tor voltage does not increase when the key is turned ON; Failure in the power section, or in the Logic PCB, or in the driver PCB, or in the motor	To remove alarm condition
74	DRIVER SHORTED	X		X	Alarm: Line contac-tor coil driver is shorted	· If the alarm is present in Init status, remove the alarm cause · If the alarm has occurred in standby or running mode, it is necessary to remove alarm cause and to activate traction request
75	CONTACTOR DRIVER	X		X	Alarm: Line contac-tor coil driver is open (not able to drive the coil to the correct voltage)	To remove alarm cause and to activate traction request
76	COIL SHORTED	X		X	Alarm: · Init: The LC and EB coil driver protection circuit is damaged · Standby or running: short on LC coil or EB coil	· If the alarm is present in Init status, remove the alarm cause · If the alarm has occurred in standby or running mode, it is necessary to remove alarm cause and to activate traction request
37	CONTACTOR CLOSED	X			Alarm: Line contac-tor power contact is stuck	To remove alarm cause within a timeout; if the timeout is elapsed, it is necessary to re-cycle the key
38	CONTACTOR OPEN	X			Alarm: Line contac-tor power contact does not pull-in	To remove alarm cause within a timeout; if the timeout is elapsed, it is necessary to re-cycle the key
82	ENCODER ERROR	X	X	X	Alarm: Motor speed sensor (encoder) does not work properly	To recycle the key
84	STEER SENSOR KO	X			Alarm: Steering poti signal out of range	To remove alarm cause
86	PEDAL WIRE KO		X	X	Alarm: Fault in accelerator negative (NPOT) input circuit	To remove alarm cause and activate a traction request
245	WRONG SET BATTERY	X		X	Alarm: The battery voltage does not correspond to SET BATTERYprogram-ming	To remove alarm cause
246	SLAVE KO	X			Alarm: Master μC detects a Slave μC malfunctioning	To recycle the key

- Failure codes -

Code	Alarm string	Master	Slave	Pump	Description	Condition that has to occur to come out from alarm status
247	MASTER KO		X		Alarm: Slave μC detects a Master μC malfunctioning or a mismatch between inputs status and Master commands (via Canbus)	To recycle the key
250	INPUT MISMATCH		X		Alarm: Slave μC has detected a mismatch between inputs status and the input status transmitted via Canbus by Master μC	To recycle the key
253	AUX OUTPUT KO	X		X	Alarm: EB coil driver shorted or open	· If the alarm is present in Init status, remove the alarm cause · If the alarm has occurred in standby or running mode, it is necessary to remove alarm cause and to activate traction request
13	EEPROM KO	X	X	X	Warning: Eeprom fault, controller will use default parameters	To remove Warning cause
61	HIGH TEMPERATURE	X	X	X	Warning: Master or Slave or both temperature higher than 75° C	To remove Warning cause
65	MOTOR TEMPERATURE	X	X	X	Warning: Master or Slave or both motors temperature high	To remove Warning cause
66	BATTERY LOW	X			Warning: Battery charge level below 10%	To remove Warning cause
71	HANDBRAKE	X			Warning: Handbrake microswitch is open and a travel request is active	To remove Warning cause
78	VACC NOT OK	X		X	Warning: Acc.signal (CPOT)voltage higher than VACC MIN +1V while the traction enable switch is open	To remove Warning cause
79	INCORRECT START	X		X	Warning: Wrong traction request sequence	To remove Warning cause
80	FORWARD + BACKWARD	X			Warning: Forward and reverse inputs are both active	To remove Warning cause
249	THERMIC SENSOR KO	X	X	X	Warning: Master or slave temp. sensor is out of range	To remove Warning cause

Code	Alarm string	Master	Slave	Pump	Description	Condition that has to occur to come out from alarm status
251	WAITING FOR NODE	X			Warning: Master μC signals that slave or pump μC is in alarm status	To remove warning cause
251	WAITING FOR NODE#3		X		Warning: Slave μC signals that master μC is in alarm status	To remove warning cause
247	NO CAN MESSAGE #X	X	X		Alarm: Master/Slave has lost Can communication with #X	To remove Alarm cause
250	CANBUS KO			X	Alarm: Inverter has lost Can communication	To remove Alarm cause
240	MOTOR STALL	X			Warning: The encoder signal is constantly zero when the maximum torque is applied to the motor	To recycle the key
243	SEQUENCE FAULT	X			Warning: An incorrect start sequence has been detected on the seat, pedal and levers commands	To remove warning cause
254	CANBUS KO DISP.	X			Alarm: Master has lost can communication with the display	
252	CHAT MODE	X			Warning: The chat time has expired	To activate traction or pump request
248	DISPLAY ENABLE	X			Warning: The display enable signal has not been received to operate the truck	To remove warning cause
242	PUMP WARNING	X			Warning: A warning is active on the pump module	To remove warning cause

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Maintenance Recommendations

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- Maintenance diagram.

PM interval
A : 8~10 hours or daily
B : 50~250 hours or every month(Typical PM interval)
C : 450~500 hours or every 3 months
D : 900~1000 hours or every 6 months
E : 2000 hours or every year

Daily maintenance checks	A	B	C	D	E
Check truck for obvious damages and leaks.	●				
Check clean battery terminals.	●				
Check electrolyte level.	●				
Check capacity, warning plates and decals.	●				
Check condition of tires and wheels. Remove embedded objects.	●				
Check for missing or loose wheel lug nuts.	●				
Check hydraulic sump oil level.	●				
Check display.	●				
Check warning lights and hourmeter.	●				
Check overhead guard condition and bolts.	●				
Check horn operation and other warning devices.	●				
Check steering operation.	●				
Check service brake operation.	●				
Check parking brake operation.	●				
Check directional and speed controls operation.	●				
Check accelerator.	●				
Check lift, tilt and auxiliary operation.	●				
Check mast, lift chains and fasteners.	●				
Check carriage or attachments and forks.	●				
Check seat deck holddown latch for correct locking.	●				
Check optional safety equipment.(Alarms, Lights etc.)	●				

PM interval
A : 8~10 hours or daily
B : 50~250 hours or every month(Typical PM interval)
C : 450~500 hours or every 3 months
D : 900~1000 hours or every 6 months
E : 2000 hours or every year

Periodic checks and planned maintenance (PM)	A	B	C	D	E
Check truck visually and inspect components.		●			
Test drive truck/check functional performance.		●			
Check torque on critical fasteners.		●			
Lubricate truck.(See component)		●			
Clean/Check battery terminals, electrolyte level.		●			
Check battery cables/truck receptacle		●			
Perform battery load test.		●			
Test ground.		●			
Clean drive axle air vent.		●			
Check drive axle fluid level.		●			
Drain and replace drive axle fluid.					●
Check drive axle mounting and fasteners.		●			
Check brake condition and wear.		●			
Lubricate steering axle linkage.		●			
Check/lubricate steering axle wheel bearings.					●
Replace hydraulic sump fluid and filter.					●
Clean/replace hydraulic sump breather.				●	
Lubricate tilt cylinder rod ends.		●			
Lubricate mast fittings.		●			
Check lift chain adjustment and wear.		●			
Check/lubricate lift chains.		●			
Lubricate mast rollers.		●			
Check contactor (Replace contactor tips if roughness is remarkable)		●			

- (15)16/18/20B(T)-7Maintenance diagram.

1) 15/18/20BT-7, 16/18/20B-7

Service point	Kind of fluid	Capacity ℓ (U.S. gal)		Ambient temperature ℃(°F)
		15/18/20BT-7	16/18/20B-7	-20 (-4) -10 (14) 0 (32) 10 (50) 20 (68) 30 (86) 40 (104)
Axle	Gear oil	0.35 (0.1)	0.35 (0.1)	ATF DEXRON III
Hydraulic oil tank	Hydraulic oil	19 (5.0)	16.5 (4.4)	ISO VG 22 / ISO VG 46 / ISO VG 68
Brake system	Brake oil	0.5 (0.1)	0.5 (0.1)	DOT 3, DOT4
Fitting (Grease nipple)	Grease	0.1 (0.03)	0.1 (0.03)	NLGI No.1 / NLGI No.2

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- 22/25/30/32B-7 Maintenance diagram.

3) 22/25/30/32B-7

Service point	Kind of fluid	Capacity ℓ (U.S. gal) 22/25/30/32B-7	Ambient temperature ℃(°F) -20 (-4) -10 (14) 0 (32) 10 (50) 20 (68) 30 (86) 40 (104)
Axle	Gear oil	2.4 (0.63)	Mobilfluid 424
Hydraulic oil tank	Hydraulic oil	24 (6.3)	ISO VG 22 ISO VG 46 ISO VG 68
Brake system	Brake oil	0.5 (0.1)	SAE 10W HYDRAULIC OIL (AZOLA ZS10)
Fitting (Grease nipple)	Grease	0.1 (0.03)	NLGI No.1 NLGI No.2

- 22/25/30BHA-7 Maintenance diagram.

4) 22/25/30BHA-7

Service point	Kind of fluid	Capacity ℓ (U.S. gal) 22/25/30BHA-7	Ambient temperature ℃(°F) -20 (-4) -10 (14) 0 (32) 10 (50) 20 (68) 30 (86) 40 (104)
Axle	Gear oil	2.4 (0.63)	Mobilfluid 424
Hydraulic oil tank	Hydraulic oil	25.4 (6.7)	ISO VG 22 ISO VG 46 ISO VG 68
Brake system	Brake oil	0.5 (0.1)	SAE 10W HYDRAULIC OIL (AZOLA ZS10)
Fitting (Grease nipple)	Grease	0.1 (0.03)	NLGI No.1 NLGI No.2

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- 35/40/45/50B-7 Maintenance diagram.

4) 35/40/45/50B-7

Service point	Kind of fluid	Capacity ℓ (U.S. gal) 35/40/45/50B-7	Ambient temperature ℃(°F) -20 (-4) -10 (14) 0 (32) 10 (50) 20 (68) 30 (86) 40 (104)
Axle	Gear oil	1.5 (0.4)	Mobilfluid 424
Hydraulic oil tank	Hydraulic oil	44.9 (11.9)	ISO VG 22 / ISO VG 46 / ISO VG 68
Brake system	Brake oil	0.5 (0.1)	DOT 3, DOT4
Fitting (Grease nipple)	Grease	0.1 (0.03)	NLGI No.1 / NLGI No.2

- Questions or remarks.